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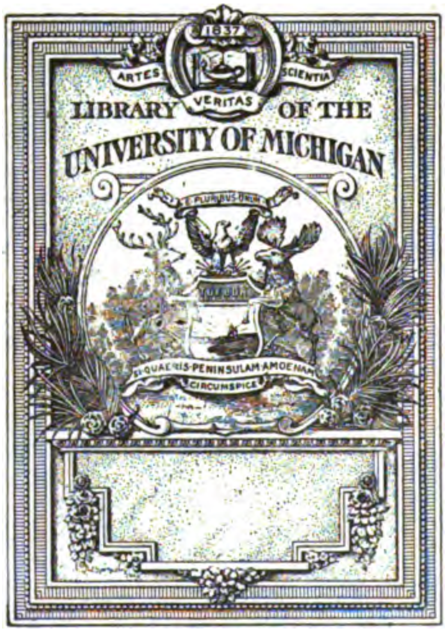

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ASSOCIATIONS
OF
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—UNITED KINGDOM—

ASSOCIATIONS

OF

GAS ENGINEERS AND MANAGERS

-UNITED KINGDOM-

REPORTS OF PROCEEDINGS

DURING

1891

OF THE

Eastern Counties Gas Managers' Association,
Manchester District Institution of Gas Engineers,
Midland Association of Gas Managers,
North British Association of Gas Managers,
North of England Gas Managers' Association,
North of Ireland Association of Gas Managers,
Scottish Gas Managers at Glasgow,
Southern District Association of Gas Engineers and Managers,
AND
South-West of England District Association of Gas Managers.

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CONTENTS.

EASTERN COUNTIES GAS MANAGERS' ASSOCIATION— PAGE
Half-Yearly Meeting at Lincoln, March 19 81
Half-Yearly Meeting at Cambridge, Sept. 16 265

MANCHESTER DISTRICT INSTITUTION OF GAS ENGINEERS—
Annual Meeting in Manchester, Feb. 28 18
Quarterly Meeting at Tarporley, May 30 132
Quarterly Meeting at Birkenhead, Aug. 29 245
Quarterly Meeting in Manchester, Nov. 28 352

MIDLAND ASSOCIATION OF GAS MANAGERS—
Annual Meeting at Birmingham, March 5 36
Quarterly Meeting at Leamington, May 21 131
Quarterly Meeting at Birmingham, Oct. 22 304

NORTH BRITISH ASSOCIATION OF GAS MANAGERS—
Annual Meeting in Edinburgh, July 23 and 24 133

NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION—
Half-Yearly Meeting in Newcastle, April 25 113
Half-Yearly Meeting at South Shields, Oct. 3 290

NORTH OF IRELAND ASSOCIATION OF GAS MANAGERS—
Annual Meeting in Belfast, Aug. 11. 214

SCOTTISH GAS MANAGERS—
Annual Meeting in Glasgow, April 10 104

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS AND MANAGERS—
Annual Meeting in London, Feb. 12 1
Excursion Meeting—Visit to Windsor, May 14 130
Quarterly Meeting in London, Nov. 12 322

SOUTH-WEST OF ENGLAND DISTRICT ASSOCIATION OF GAS MANAGERS—
Half-Yearly Meeting at Southampton, March 10 59
Half-Yearly Meeting at Weymouth, Sept. 8. 251

198537

ILLUSTRATIONS, &c.

TO FACE PAGE

PLATE.—Table showing Results of Experiments with Elliott's Process of Continuous Carbonizing at the Swan Village (Birmingham) Gas-Works 312

PAGE

FIG. 1.—King's Choked Pipe and Smoke Preventer 68

„ 2.—Section of Purifier, showing Results of Mr. F. G. Dexter's Purification Experiments. 73

„ 3.—General Arrangement of Plant employed in Elliott's Process of Continuous Carbonizing 308

„ 4.—Longitudinal Elevation of Retort-House, fitted with West's Wire-Rope Machinery, at the East Greenwich Gas-Works 324

„ 5.—Plan of ditto 324

„ 6.—Cross Section of ditto 325

„ 7.—Tysoe's Improved Charging-Scoop: Plan and Sectional Elevation, showing the Scoop Open and Closed . . 328

„ 8.—Foulis's Patent Retort-Drawing Machine 330

INDEX.

PAGE
Armour, Mr. L. H.—Paper on a Simple Method of Preventing Stoppages in Ascension Pipes . . . 295
Barratt, Mr. W.—Paper on Gas Meters . . . 91
Burner for Gas-Testing Purposes, Mr. G. R. Hislop on a New form of . . . 145
Carbonizing by Machinery, Mr. J. Tysoe on . . . 322
Carter, Mr. J.—Inaugural Address to the Eastern Counties Gas Managers' Association . . . 84
Dexter, Mr. F. G.—Paper on the Revivification of Oxide of Iron in Closed Boxes . . . 71
Differential Rates, Mr. T. Newbigging on . . . 247, 352
Distillation of Tar and Ammoniacal Liquor by Owners of Gas Works, Mr. William Hardy, on the . . . 121
District Pressure, Mr. David Terrace on . . . 114
Durkin, Mr. S. W.—Inaugural Address to the South-West of England District Association of Gas Managers . . . 59
Eastern Counties Gas Managers' Asssociation—
  Annual Report of the Committee . . . 82
  Barratt, Mr. W., on Gas Meters . . . 91
    Discussion . . . 95
  Election of Office-Bearers . . . 288
  General Business . . . 81, 90, 265, 288
  List of Office-Bearers and Members . . . 377
  President's (Mr. J. Carter's) Inaugural Address . . . 84
  Storeage of Coal, Discussion on the . . . 281
  Ward, Mr. F. J., on Gas Works Rating . . . 274
    Discussion . . . 277
  Weller, Mr. F., on the Economical Working of Small Gas Works . . . 266
    Discussion . . . 270
Ellery, Mr. C. Stafford—Presidential Address to the Midland Association of Gas Managers . . . 37
Elliott's Process of Continuous Carbonizing, Mr. H. Hack on . . . 305
Frizelle, Mr. T.—Paper on the Manufacture of Sulphate of Ammonia in Small Gas Works . . . 239
Gas Meters, Mr. W. Barratt on . . . 91

PAGE

Hack, Mr. H.—Paper on Elliott's Process of Continuous Carbonizing 305
Hardie, Mr. William—Paper on the Distillation of Tar and Ammoniacal Liquor by Owners of Gas Works 121
Herring, Mr. R.—Paper on a Rapid Method for Increasing the Yield of Gas from Ordinary Retort Settings 344
Hislop, Mr. G. R.—Paper on a New Form of Burner specially adopted for Gas-Testing Purposes 145
Hydraulic Main, Mr. E. C. Riley on the Position and Working of the 64
Irving, Mr. D.—Paper on the Storeage of Coal in Gas Works 253
Jones, Mr. C. E., on the Storeage of Coal 281
Labour Saving Appliances for Gas Works, Mr. John West on 154, 360
Lewis, Mr. J. T.—Paper on Weekly and Monthly Payments for Gas (Discussion) 47
Lime Burning, Mr. T. Newbigging on (Discussion) 32
Love, Mr. G.—Paper on the Construction and Working of Regenerative Retort Settings 180
Macfie, Mr. D.—Paper on Regenerative Gas Lamps 200
Manchester District Institution of Gas Engineers—
  Annual Report of the Committee 18
  Election of Office Bearers 19, 352
  Excursion to Beeston Castle 132
  General Business 18, 31, 132, 245, 352
  List of Office Bearers and Members 379
  Newbigging, Mr. T., on Differential Rates 247, 352
    Lime Burning (Discussion) 32
  President's (Mr. T. O. Paterson's) Inaugural Address . . . 20
  Visit to the Gas Works and Messrs. Lairds' Shipbuilding Yard at Birkenhead 245
  West, Mr. John, on Stoking Machinery, &c.. 360
    Discussion 370
Methven, Mr. J.—Inaugural Address to the Southern District Association of Gas Engineers and Managers. 3
Midland Association of Gas Managers—
  Annual Report of the Committee 36
  Appointment of a Committee to Investigate the Working of Elliott's Retort Charging Apparatus 320
  Election of Office Bearers 304
  Excursion to Leamington and Warwick 131
  General Business 37, 58, 131, 304
  Hack, Mr. H., on Elliott's Process of Continuous Carbonizing 305
  Lewis, Mr. J. T., on Weekly and Monthly Payments for Gas (Discussion) 47
  List of Office Bearers and Members 382
  President's (Mr. C. Stafford Ellery's) Inaugural Address . . 37
  Visit to the Birmingham Oxygen Company's Works . . . 320

PAGE

Newbigging, Mr. T.—Paper on Differential Rates 247, 352
  Lime Burning (Discussion) . . 32

North British Association of Gas Managers—
  Annual Report of the Committee 133
  Election of Office Bearers 179
  General Business 133, 212
  Hislop, Mr. G. R., on a New Form of Burner especially adapted for Gas Testing Purposes 145
    Discussion 150
  List of Office Bearers and Members 384
  Love, Mr. G., on the Construction of Working of Regenerative Retort Settings 180
    Discussion 187
  Macfie, Mr. D., on Regenerative Gas Lamps 200
  Murdoch Memorial Fund, The 135
  President's (Mr. R. Robertson's) Inaugural Address 137
  Question Box, The 212
  Robertson, Mr. D., on Unaccounted for Gas 192
    Discussion 196
  Visit to the Edinburgh Gas Works 178
  West, Mr. John, on Labour Saving Appliances for Gas Works 154
    Discussion 171

North of England Gas Managers' Association—
  Armour, Mr. L. H., on a Simple Method of Preventing Stoppages in Ascension Pipes 295
    Discussion 297
  Election of Office Bearers 129
  General Business 113, 290, 303
  Hardie, Mr. William, on the Distillation of Tar and Ammoniacal Liquor by Owners of Gas Works 121
    Discussion 124
  List of Office Bearers and Members 389
  President's (Mr. R. Wallis's) Inaugural Address 291
  Terrace, Mr. David, on District Pressure 114
    Discussion 118

North of Ireland Association of Gas Managers—
  Annual Report of the Committee 214
  Election of Office Bearers 215
  Frizelle, Mr. T., on the Manufacture of Sulphate of Ammonia in Small Gas Works 239
    Discussion 241
  General Business 215, 244
  List of Office Bearers and Members 392
  President's (Mr. R. Ross's) Inaugural Address 216
  Williamson, Mr. D., on the Supply of Gas by Companies and Corporations 224
    Discussion 230

PAGE
Paterson, Mr. T. O.—Inaugural Address to the Manchester District Institution of Gas Engineers 20
Presidential Addresses—
  Carter, Mr. J. (Eastern Counties Association) 84
  Durkin, Mr. S. W. (South-West Association) 59
  Ellery, Mr. C. Stafford (Midland Association) 37
  Methven, Mr. J. (Southern District Association) 3
  Paterson, Mr. T. O. (Manchester Institution) 20
  Robertson, Mr. R. (North British Association) 137
  Ross, Mr. R. (North of Ireland Association) 216
  Wallis, Mr. R. (North of England Association) 291
Rating of Gas Works, Mr. F. J. Ward on the 274
Regenerative Gas Lamps, Mr. D. Macfie on 200
Regenerative Retort Settings, Mr. G. Love on 180
Revivification of Oxide of Iron in Closed Boxes, Mr. F. G. Dexter on the 71
Riley, Mr. E. C.—Paper on the Position and Working of the Hydraulic Main 64
Robertson, Mr. D.—Paper on Unaccounted for Gas 192
Robertson, Mr. R.—
  Address to the Scottish Gas Managers 104
  Inaugural Address to the North British Association of Gas Managers 137
Ross, Mr. R.—Inaugural Address to the North of Ireland Association of Gas Managers 216
Scottish Gas Managers—
  Chairman's (Mr. R. Robertson's) Address 104
    Discussion 108
Small Gas Works, Mr. F. Weller on the Economical Working of 270
Southern District Association of Gas Engineers and Managers—
  Annual Report of the Committee 1
  Election of Office-Bearers 322
  General Business 2, 322
  Herring, Mr. R., on a Rapid Method for Increasing the Yield of Gas from Ordinary Retort Settings 344
    Discussion 347
  List of Office-Bearers and Members 394
  President's (Mr. John Methven's) Inaugural Address 3
  Tysoe, Mr. J., on Carbonizing by Machinery 322
    Discussion 336
  Visit to Windsor 130
South-West of England District Association of Gas Managers—
  Dexter, Mr. F. G., on the Revivification of Oxide of Iron in Closed Boxes 71
    Discussion 77
  Election of Office-Bearers 252
  General Business 59, 251, 264

PAGE
South-West Association (*continued*)—
  Irving, Mr. D., on the Storeage of Coal in Gas Works . . . 253
    Discussion 258
  List of Office-Bearers and Members. 397
  President's (Mr. S. W. Durkin's) Inaugural Address.. . . . 59
  Riley, Mr. E. C., on the Position and Working of the Hydraulic Main. 64
    Discussion 67
Stoking Machinery, &c., Mr. John West on 154, 360
Stoppages in Ascension Pipes, Mr. L. H. Armour on a Simple Method of Preventing 295
Storeage of Coal—
  Discussion on, at the Meeting of the Eastern Counties Gas Managers' Association 281
  Irving, Mr. D., on the 253
Sulphate of Ammonia, Mr. T. Frizelle on the Manufacture of, by Small Gas Works 239
Supply of Gas by Companies and Corporations, Mr. D. Williamson on the 224
Terrace, Mr. David—Paper on District Pressure 114
Tysoe, Mr. J.—Paper on Carbonizing by Machinery 322
Unaccounted-for Gas, Mr. D. Robertson on 192
Wallis, Mr. R.—Presidential Address to the North of England Gas Managers' Association. 291
Ward, Mr. F. J.—Paper on Gas Works Rating 274
Weekly and Monthly Payments for Gas, Mr. J. T. Lewis on (Discussion) 47
Weller, Mr. F.—Paper on the Economical Working of a Small Gas Works 266
West, Mr. John—
  Paper on Labour Saving Appliances for Gas Works . . . 154
  Paper on Stoking Machinery, &c. 360
Williamson, Mr. D.—Paper on the Supply of Gas by Companies and Corporations 224
Yield of Gas from Ordinary Retort Settings, Mr. R. Herring on a Rapid Method for Increasing the 344

REPORTS OF PROCEEDINGS.

ASSOCIATIONS OF
GAS ENGINEERS AND MANAGERS
—UNITED KINGDOM—
1891.

SOUTHERN ASSOCIATION.

ANNUAL MEETING, FEB. 12.

This Meeting was held at the Holborn Restaurant, London—Mr. John Methven, Assoc. M. Inst. C.E., of the Nine Elms works of The Gaslight and Coke Company (the President), in the chair.

The record of the proceedings at the previous meeting, presented by the Honorary Secretary (Mr. Jas. W. Helps, of Croydon), was taken as read.

Committee's Annual Report.

The Honorary Secretary next read the annual report of the Committee, as follows:—

In presenting this the sixteenth annual report, the Committee have much pleasure in congratulating the members on the continued prosperity of the Association ; six new members having been enrolled during the year. The members will learn with regret that three members have been lost during the same period—one by death (Mr. T. Cowling, of Burgess Hill, who had been a member since 1878), one by resignation, and one cut off under Rule 20. The present number of members is 88, compared with 85 in 1889.

Three meetings have been held during the year, all of which have been exceedingly interesting and profitable. The first, and annual meeting, was held at the Hôtel Métropole, on Feb. 13, when a very instructive Inaugural Address was read by the President, Mr. T. May, in which he discoursed upon subjects of the greatest interest to gas engineers. The adjourned discussion of Mr. J. Methven's paper on "Photometry" was also taken ; and a good debate resulted. After this a congratulatory vote was unanimously accorded to Mr. G. Livesey, upon the success with which he had dealt with the strike at the South Metropolitan Gas-Works during the winter.

The second, or outdoor May meeting, comprised a visit to the gas-works at Richmond, where the members were received by the President, who conducted them over the works, which have recently been reconstructed and enlarged. The many valuable points of interest were fully explained; and luncheon, kindly provided by the Directors of the Company, was then partaken of. The members afterwards journeyed by train to Hampton Wick, where steam launches were in readiness, and a very pleasant trip was taken up the Thames to Staines.

The third meeting was held at the Holborn Restaurant, when a large number of members and friends met together to hear two admirable papers. One was by Mr. Frank Livesey (London), on "A Ready Means of Enriching Coal Gas," in which he dealt with the ease and success with which gas could be enriched by gasoline. The second paper was read by Mr. H. Smythe (Maidstone) on "Gas Distribution," when some interesting particulars were given of the effect of various sizes of pipes on leakage and the formation of naphthalene. Good discussions on both papers resulted.

The funds of the Association continue in a satisfactory condition; the balance to be carried forward being £41 19s. 1d., compared with £40 4s. 11d. in 1889. The Committee therefore feel justified in again sending each member a copy of the Reports of the District Associations, and trust it will be found a valuable record.

The Committee cannot close this report without again acknowledging the indebtedness of the Association to the Honorary Secretary (Mr. J. W. Helps), for the zeal and energy which he has shown in furthering the interests of the Association during the past year.

On the motion of the PRESIDENT, seconded by Mr. JAMES L. CHAPMAN (Harrow), the report was adopted.

ELECTION OF NEW MEMBERS.

The PRESIDENT proposed, in accordance with the recommendation of the Committee, that the following gentlemen be elected members of the Association: Mr. C. F. Ruggles, of Leighton Buzzard; Mr. C. King, of High Wycombe; and Mr. F. M. Edwards, of St. Paul's Cray, Kent.

Mr. D. FORD GODDARD (Ipswich) seconded the proposition, which was unanimously agreed to.

ALTERATION OF RULE.

Mr. GODDARD said that, on behalf of the Committee, he had to make a proposal in regard to Rule 4. At present the rule read: "All Past-Presidents shall be Vice-Presidents and *ex-officio* members of the Committee." He had to move that it be altered as follows: "Past-Presidents shall be Vice-Presidents and *ex-officio* members of Committee for seven years after the completion of their year of office." He did not think it required any words to recommend this alteration to the members for their approval; as it was manifestly unnecessary and undesirable that those gentlemen who had served the Association in the chair should for ever afterwards continue to be members of the Committee.

Mr. W. H. H. **Broadberry** (Tottenham) seconded the motion, and it was passed *nem. con.*

The **President** then read the following

INAUGURAL ADDRESS.

Gentlemen,—The year 1890 will, I have no hesitation in saying, be one which will not soon be forgotten by those connected with the gas industry. Its opening brought us face to face with a condition of the labour market such as we have not experienced for years. Not only has the labour market with which we are intimately associated been in a turbulent state, but labour throughout the country has been equally affected—wrought up to the highest pitch of excitement, and clamouring for a reduction of hours and increased pay. This has had its effect on the gas industry, perhaps more than on any other; and it has left its mark, not only on the labour we employ, but also on the materials we use in our manufacture. As the year advanced, concessions that were made told their tale. Matters assumed a quieter condition; and we gradually reconciled ourselves to our position. The close of the year brought with it an early and severe winter, the rigour of which taxed the oldest inhabitant to remember its equal. But, notwithstanding this, we are able to chronicle good times for gas companies; and we have each of us a record of heavy increases in our business, which perhaps affords the best solace for the anxieties and troubles connected with this extraordinary year.

Coal.—There is every prospect of the price of gas coals being as high this year as it was in 1890. Labour in the coal-fields is still unsettled; and, in addition to demands for advances in wages, the men are now contemplating taking steps to secure an eight-hour working day. This looks as if the output of coal is more likely to be restricted than increased; and the maintenance of high prices will necessarily follow. The unequal demand for coal for gas making throughout the year is, or has been, to the colliery proprietors a good excuse for threatening to increase the price; and now that they are pressed so much by their men, it is very likely that their threats will take effect, unless gas companies make some arrangement for receiving their supplies in more regular monthly deliveries. This, as a matter of course, will involve the necessity for maintaining large stocks of coal during the summer months; and I fear gas companies must submit very quietly to any loss such large stocks may entail, and endeavour, as much as possible, to minimize it. The loss to which I particularly refer is that likely to be sustained by spontaneous combustion. In the generality of gas-works, accommodation for an increase in the quantity of coals to be stored would probably have to be sought in the open. My experience with coal stored both under cover and in the open gives the preference, in the matter of disposition to heat, to the former. It may be that my under-cover stores possess some inducement for the coal to heat, from their relative position to the retort-houses, where undoubtedly the temperature is much higher than in the open. These stores, when full, contain a depth of rather more than 30 feet of coal; and it is no uncommon occurrence for them to fire after having been filled only two or three months. On the other hand, that portion of my stock stored this year outside, with no protection from the weather for upwards of six months, was carbonized without the indication of any loss from heating. It is necessary to take the precaution of providing a suitable surface for the reception of the coal; and it should be formed with a good fall, for preventing any accumulation of water under the coals, and should be made of concrete, which would entirely separate the coal from any moisture the earth might contain. I have recently seen a heap of between 20,000 and 30,000 tons of coal stored in a field, without any precautions having been taken to separate the coal from the natural surface of the earth, from which, with little doubt, it would extract moisture, which in its turn would develop the deplorable results of heating which have unfortunately manifested themselves.

I have hitherto only referred to large stocks of coal being necessary from the concerted action of the coal miners. There are other reasons of equal weight. The same influence which agitates the miner, and restricts the coal output, has its effect on the labour conveying the coal from the mines. It is within the bounds of possibility that some trifling cause will prevent the colliers sailing after they are loaded; and perhaps when your coals arrive in the river, the labour for discharging them might get contaminated by the same influence. Again, with matters in the respective labour markets working perfectly smoothly, large stocks are indispensable, if only to guard against fogs—the *bête noire* of the Metropolitan gas manager. This memorable winter, with its prolonged frost, high barometer, and anti-cyclonic condition of the atmosphere, was particularly productive of fogs, which, coupled with the accumulation of ice in the river, very nearly brought to a standstill navigation in the Pool and above-bridge. One placed in the position with such surroundings, carbonizing more than 1000 tons a day, and whose stock was reduced to one day's consumption, may naturally be excused for dwelling to some extent on the necessities for large storeage of coal.

Admitting that larger stocks of coal than formerly are inevitable, it will be necessary in most works to provide viaducts for economically depositing the coals, and efficient apparatus for picking them up as required. To counterbalance the influence before alluded to, some of the London Gas Companies conceded to the demands of the men, with the result that every ton of coal unloaded cost them 4d. This, added to the cost of lifting, tipping, and depositing into stores, increases the total figure for long distances to very nearly 9d. per ton. This is a formidable amount; and the introduction of any system of filling, lifting, and tipping, which tends to reduce this expenditure, will be hailed with satisfaction. Such appliances in the form of powerful cranes actuating "grabs," which are also self-emptying, have recently been introduced into some of the Metropolitan works, and I am informed are acting satisfactorily, and effecting a large saving in the cost of working. These grabs are, as their name implies, self-filling, so long as the coals in the barges remain in heaps; and thus all the necessary labour in the barge is employed in collecting the leavings of the grab, and placing them within its reach. This cost, I am informed, does not exceed 0·6d. per ton, compared with the present filling rate of 4d. by manual labour. These improved cranes and grabs are in satisfactory operation at the Kensal Green works of The Gaslight and Coke Company, combined with an elaborate, yet simple, system of elevators and conveyors, by means of which the coal is conveyed either into store or into hoppers ready for filling the scoops for charging the retorts. By these means the cost of coal-shifting within the works is reduced to a minimum. A general introduction of such a system as the one referred to cannot fail to make its mark with good effect on the revenue accounts of a company.

With regard to cannel coal, the increased consumption of which is the result of the recent action of the Metropolitan Gas Referees, in the alteration of the photometers, affairs are assuming an alarming condition. I ventured to prognosticate, in the paper I had the honour of reading before you on "Photometry,"* that it would be impossible to procure coal of sufficient quality and quantity to make gas which would comply with the altered statutory requirements; and so it has turned out. Cannel coal is not to be obtained in the quantities required; and at one time during the past winter supplies were very difficult to procure. This state of matters was possibly aggravated by the Scotch railway strike. Following the usual laws of supply and demand, it is hardly to be wondered at that prices at this time should have assumed almost a prohibitive figure. The published accounts of The Gaslight and Coke Company for the six months ending December, 1890, show that the increased quantity of cannel coal used was 26,864 tons, as compared with the corresponding period of the previous year. These are large figures to deal with; and the contemplation of the rapidly diminishing output of cannel from our coal-fields makes the introduction of another element a *quasi quâ non.*

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* See "Reports of Gas Associations" for 1889, p. 356.

To meet this condition of affairs, it is satisfactory to learn that there are inventions in the field likely to provide a convenient substitute for cannel coal. I refer particularly to the carburetting system, the working of which was laid before us at our last meeting in the valuable paper contributed by Mr. Frank Livesey.* I look forward to a good future for this invention; and, when confidence in its working is well established, it will prove a great boon to gas makers. We shall be able to continue in the future, as in the past, to get more gas from a ton of coal of a lower quality; and the carrying power of such gas for the vaporized hydrocarbon will be enhanced. Petroleum can also be used with advantage by mixing it with small coal, and inserting it in the retort in the third scoop of an ordinary charge. The use of 1 per cent. of refined petroleum, having a specific gravity of ·830, is enough to add 2 candles additional quality to 16-candle gas. Experiments conducted on a large scale with astatki—a form of petroleum residuum—were made at Nine Elms, by mixing it with fine dry breeze, which it was thought would, by its porous condition, carry a larger quantity; but the inert material with which it was mixed told its tale on the quantity of gas produced, which was much less than it ought to have been at the station meter. The improvement in the quality of the gas showed itself at the exhausters; but was not so marked at the meters. It was consequently inferred that the bulk of its enriching qualities was absorbed by the apparatus through which it passed. Eventually, however, it was found that about one-half the weight of astatki, compared with Lesmahago cannel produced similar results in the quality of the gas. When these heavy petroleums are employed, I consider it desirable that special apparatus and plant should be adopted. The inconvenience and cost of using it in the retorts, mixed either with the coal or otherwise, renders it unsatisfactory; and when oils of lighter specific gravity are used, great care has necessarily to be taken to guard against dangers inseparable from its use. I think there can be little doubt that the best method of enriching gas by the aid of petroleum is by combining it with a water-gas plant, in which case a gas is produced possessing great power for associating itself with the hydrocarbon vapours with which it is brought into contact. Carburetted water gas thus made could then be mixed in sufficient quantity with the ordinary gas to give to the whole the necessary increase of light-value. Plant for this purpose has recently been erected at Beckton, where, we are informed, it is working satisfactorily. It is well, therefore, considering the dearth of cannel coal, that we have some other material to which we may devote attention, to afford us a means of enriching our gas to enable us to comply with the present statutory requirements.

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* See "Reports of Gas Associations" for 1890, p. 321.

Carbonizing Plant.—It is now some years since regenerative furnaces were introduced into this country; and experience of their value has been generally obtained. There can be little doubt that the prevailing opinion is that, as far as the consumption of fuel is concerned, for the same quantity of work done, they are by far the most economical form of furnace. My experience in their use leads me to believe that there is a certain saving effected by heating the necessary bulk of secondary air supply for the combustion of the gas produced in the generator; but I am equally convinced that by far the greater amount of saving is brought about by the enlargement of the furnace, which, of course, is a *sine quâ non* of the generator furnace. Those of us who, during the last few years, have been altering our open furnaces to generator furnaces have only to compare the quality of the pan breeze now made with what it was before the introduction of the more modern system, in order to form a conclusion as to the cause of the alteration in the breeze. Open furnaces in use require to be clinkered and cleaned four times in twenty-four hours; and each time a quantity of breeze is removed with the clinkers to the heap. Compare this with the regenerative or producer furnace, where the clinkering or cleaning is only performed once in twenty-four hours; and, finally, compare the material taken from the furnace. It is only a mixture of clinkers and ashes; there is nothing in it which can be called breeze. In fact, it is quite worthless for fuel, so much so that at Nine Elms our present price for pan breeze is 3d. per ton, whereas in the days of the old furnaces the prices were between 2s. and 3s. per ton.

There is another saving, the value of which is not quite so easily estimated as the first I have mentioned, and that is the greater regularity of heat in the setting. The long time which elapses between the cleanings of the furnace, and the use of false bars to keep up the coke during the operation, maintain a uniform temperature within the setting. Open furnaces—at least, many forms of them—necessitated their being emptied four times during the day for the purpose of clinkering. This resulted in a loss of temperature within the setting, which told its tale on the production of gas per mouthpiece. Taking advantage of this experience, I have introduced the use of false bars into all my open furnaces at present in use. The clinkers are now removed from the furnaces while they are full of incandescent coke; and the result is a maintenance of temperature within the setting which was not experienced before. To make this system clear, I should say that a setting of six retorts is a convenient one for the purpose, as it allows the formation of a deep and narrow furnace, which, when full of coke, exerts its full influence on the retorts which surround it. The furnace has two doors—one at the bottom for cleaning, the other at the top for feeding—and an aperture between the two, closed with a sight-plug when not in use, for the introduction of the false bars. The depth of this furnace, when fully charged, produces occasionally carbonic oxide, in order to burn which I introduce a small drain-pipe, for the admission of air from the front of the bed. This pipe reaches to the first cross wall in the setting, and is sufficient to heat the incoming air for the combustion of the carbonic oxide formed.

While on the subject of furnaces, I must mention that last year, in one of my retort-houses, I substituted for direct-firing furnaces the system recently introduced by our friend Mr. Carpenter.* Instead of 56 furnaces in this house, I now have only 16. Formerly these furnaces absorbed the work of 5·6 men in each shift, or (say) 17 men per day, which at the rate of 5s. 7d. per man amounts to £4 14s. 11d. With Mr. Carpenter's system, the 28 beds are heated by 16 furnaces; and they are attended to by two firemen and two assistants in each 24 hours. Including the cost of two men on the stage, whose duty it is to take off and replace the lids on the charging-doors of the furnaces and keep them luted with sand, the total wages now amount to £1 8s. 10d. per 24 hours, which shows a clear saving in labour of 46s. 1d. per day. But this is not the only saving we experience. We have the improved and regular heats throughout the house, which, as I have before mentioned, is difficult to estimate in any other way than by observing the working of the house alone. This, I may say, has turned out to be of a very satisfactory character; and therefore I can confidently recommend the adoption of the system to anyone who at present entertains doubts as to its value.

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* See "Reports of Gas Associations" for 1886, p. 236.

A very important matter connected with furnaces of all kinds is the material of which they are constructed. My experience has led me to pin my faith to the red Ewell bricks. The facility with which they can be rubbed, so as to make the thickness of the joint as fine as possible, is a great advantage these bricks possess. They are only serviceable when in contact with heat, and must not be used in the vicinity of water from the ash-pan, or else they will never harden. But for the sides of the furnace, above the reach of the clinkering-bar, they are of great value; and I know nothing to stand better the action of the fire. I have lately used them with advantage in the most vulnerable positions of the retort-settings.

From the number of the sizes and shapes of fire-clay retorts, a variety of opinions must exist as to the best form. Those who have had experience with the shallow ⌓ retort, if they have had the opportunity of making comparisons of their work with other shapes, will, I think, have no difficulty in awarding merit to them. There is no doubt, in these days of high heats, that the sooner the gas leaves the retort after it has been given off from the charge, the better it is for the gas; and therefore the shallower the depth of the retort, the sooner is this effected. The shallow retort is an advantage in another way. Every time the retort is charged a certain quantity of air is sealed up when the doors are closed. It consequently follows that the shallower the retort the less space is there left above the charge for air. I have made a calculation which rather surprised me—that, with even a shallow retort and an average length of ascension-pipe, the process of re-charging it every six hours permits of the introduction of rather more than 1 per cent. of air, which is, of course, mixed with the gas.

There are now very few of us who have not discarded the old-fashioned luted lid, and adopted the more modern faced joint. Any shape for faced joints but that of a circular lid is liable to give considerable trouble from leakage, owing to the difficulty of equally distributing the pressure on the surface by the fastening; and this ought consequently to be avoided. Mouthpieces for ⌓ retorts are now generally made with circular lids. When of this form, they have the advantage of forming a receptacle for the tar which comes over in such abundance during the early hours of the charge. The gas from the latter period of the charge licks up the tar which has thus accumulated; and with good heats, none of itremains at the end. With indifferent heats, an accumulation of tar remains behind; and this, when collected and measured, has been found to equal very nearly one gallon per ton of coal carbonized. It is advisable, when opening the lids, to use a dished shovel for the purpose of collecting any tar in the mouthpiece; and this may with advantage be thrown on the coals ready for the next charge. Ascension-pipes attached to mouthpieces of this form are not so likely to choke. The depth of all the new mouthpieces we are using at Nine Elms is 20 inches. This affords a good space between the pipes and the front of the beds, and results in more condensation in the ascension-pipes, and consequently less liability to any choking.

For anti-dips of all kinds, I have no appreciation whatever. My experience in their use has given me the impression that they answer their purpose where make is an object, and illuminating power and purity are of no importance. The absence of a seal to the dip-pipe causes the retort to be continuously in a porous condition, probably owing to the want of its coating of carbon; and I have observed, as a consequence of the use of the anti-dip, retorts when open permitting furnace gases to pass through their cracks. On the other hand, with a hydraulic seal the retort is always under pressure, its porosity is sealed with its coating of carbon, and a much better quality of gas is produced, owing to the exclusion of other gases which ought to pass into the chimney and escape.

Condensing Plant.—With regard to the removal of tar from the hydraulic main, in this I am a firm believer; but I do not hold with its further separation from the gas in the condensing main. I would advise its return to its old associations as soon as practicable after its removal from the bottom of the hydraulic main. In this way the naphthalene which has been dissociated from the tar, either in the retort or in the ascension-pipe, will find the only medium for dissolving it in the tar with which it is again brought into contact in the condenser. If the tar is not returned into the condensing system, then the trouble is continually to be met with of mains and apparatus becoming completely blocked as the temperature of the gas is reduced. The temperature of the condensing plant is a most important factor, and the limit of 70° Fahr. is the lowest it should touch; otherwise the tarry vapour will attack the other and lighter hydrocarbons in the gas, with the well-known result. Condensing before exhausting, the tar should accompany the gas up to a point close to the exhausters, and then be finally separated. The practice at Nine Elms—and I have every reason to recommend it—is to have, on the different mains leading to the exhausters, a vacuum larger than is actually required in the retort-houses, and to fix on each house a throttle-valve actuated by a balanced gasholder, so that any desired vacuum may be had in one house, independently of what is required in another.

Exhausting Plant.—Exhausters pumping gas at a temperature of 70° Fahr. have been for years successfully worked at Nine Elms without the use of any other lubricant internally than distilled water, obtained by passing clean steam through a condenser in a water-tank. This water mixes with the light oils in the gas, with the result that a useful and cheap lubricant is produced. Recent inspection of the interior of one of these exhausters revealed the presence of ample lubrication; and there was no indication of any result likely to ensue from the absence of it. We have two of our large exhausters fitted with W. B. Wright's three-blade system, and derive the best results from the absence of oscillation. The power of the exhausters has been increased with very little additional work on the engines, which are combined with the exhauster. The whole of the engines and exhausters at Nine Elms are of the combined type, and belt gearing has been entirely dispensed with.

Scrubbing Plant.—Experience, especially during the recent severe frost, has marked the necessity for maintaining good temperatures in the scrubbers. In order to prevent the deposit of illuminants from the gas, the precaution should be taken to warm to 70° Fahr. (at least) the water for the elimination of the final trace of ammonia. This will necessitate the use of a greater quantity of water and a production of weak liquor, which must be pumped over a liquor scrubber in order to make it of marketable strength. The extent to which it is advisable to wash or scrub the gas is a debateable point. Passing through such a prolonged frost as we have had this winter, must have revealed to many of us weak points in the system of manufacture; and especially has this been the case in my system of ammonia purification. The great service of a liquor scrubber as an aid to sulphur purification is a strong temptation to disregard its operation in an injurious direction on the illuminants in the gas; and so I found it in the middle of January's frost. I was sensible that the illuminants were being scrubbed out of my gas; and, with the cold operating at the same time detrimentally on the activity of my lime vessels, I had not the courage to bye-pass the scrubber, for fear of the inevitable result of being overwhelmed with carbonic acid in my lime vessels. This I mention as one of the small anxieties which lately have confronted at least one of the Metropolitan gas engineers. To run the risk of having one's Company mulcted in penalties, on the one hand for their gas being below the standard of illuminating power, and on the other for its containing more than the statutory limit of sulphur compounds, is an attribute of the profession of a gas engineer of the present day which was quite unknown to our fathers. This, however, is a digression. To sum up the consideration of the scrubbers, I think that scrubbing gas, through a large vessel filled with coke, with liquor which, by continued use, has saturated the contents with tarry matter, is a system to be avoided. We require a surface to the material which will not allow the adherence of tar in any form. My impression is that shallow washers offer the best means of bringing the gas into contact with liquor, with the least possible amount of injury to the illuminating power.

Purifying Plant.—In the matter of the elimination of the sulphur compounds, my experience has been gained by what is now generally known as the air system. I have succeeded in having from the official testing-places returns well under the statutory limit, by a continuous use of 1 per cent. of air drawn in and mixed with the gas at the inlet of the exhauster. Our esteemed immediate Past-President, in his address told us that he considered from 3 to 4 per cent. of air a safe working limit. Possibly it is, where the statutory quality of the gas is only 15 candles; but in the Metropolis, where 16 candles is the limit, with the *quasi* improved photometer testing against one, circumstances are entirely altered, so much so that I find it convenient not to exceed 1 per cent. This in ordinary weather is enough to keep the sulphur boxes in an active condition. When the cold is excessive, it may be necessary to put a steam connection into the water-seals of the boxes, and thus increase the temperature of the interior. This I have tried with good results. A further precaution has been taken, to cover the interior surface of the bottoms of the purifiers with breeze concrete. This, if laid with a slope, affords a good means of draining the boxes; and at the same time it excludes the external cold, and is especially necessary when the purifiers are above ground, and much exposed to the weather. The air system involves the sacrifice of the sulphur, which is removed in the spent lime to the extent of upwards of 10 per cent. This is found in practice to be not worth recovery from the lime; but inasmuch as, compared with other systems of purification, the item of sulphur does not materially alter the cost, it must not be considered a great disadvantage. There is an advantage worth mentioning attached to the air system, and that is the facility it affords for thoroughly carbonating the spent lime—a serious consideration, when the works are situated in a populous locality, and where one has to study nuisance. The disposal of the condensation from the lime-boxes is an important matter. It should not be run into the liquor-tank—the usual receptacle for all kinds of condensation—but should be conveyed into a small precipitating-tank, mixed with ammoniacal liquor, which will throw down a copious precipitate of lime. This will settle to the bottom of the tank, when the clear liquid may be run into the liquor-tank without any bad result. If it is allowed to go there direct, without the medium of precipitation, it will eventually decrease the working capacity of the tank.

I am an advocate for placing purifiers under cover, and erecting them on the first floor of the building, with a floor above them for the preparation of the lime and the revivification of the oxide. In the case of lime this is especially useful, as, when prepared for use, it can be dropped into the purifiers through canvas shoots; and with the purifiers constructed with the discharging outlets at the bottom, all the labour of charging and emptying can be performed without the necessity of carrying the stuff on men's backs. The advantages in labour-saving are quite sufficient to justify the expenditure of the additional capital necessary for the erection of the house on these lines. There is also an advantage by this system in the saving of ground area. Necessity compelled an upward direction to be taken in the extension of the purifying plant at Nine Elms, for floor space was not available. I will give an instance of the facilities for working a house of this construction. It is almost an every-day occurrence to discharge and re-charge a box 40 feet by 26 feet, containing upwards of 60 yards of slaked lime, in something less than 5 hours. This is a great advantage; and although it is the last I shall mention, it is far from being the least in importance.

Labour and Labour-Saving Appliances.—That portion of the labour market immediately connected with the manufacture of gas is for the present in a very tranquil condition. Perhaps there is the best of reasons for this state of affairs, which, I take it, is that the heavy concessions which have been granted have practically met the demands made upon us, and that the labour market is satisfied. With regard to carbonizing labour, the alteration from two to three shifts in 24 hours has made stoking easy work; and experience during the past winter season has proved that this particular labour is much sought after. Differing from the winter of 1889-90, this season has brought with it abundance of labour eager to do stokers' work. Another experience which I have pleasure in recording is that a season of less trouble, as far as the behaviour of the men is concerned, has not been remembered at Nine Elms. Eagerness has been shown by all hands to fall in with the 28 days' agreement; and, so far as I have observed it, the influence of the Union rules has had a marked effect on the conduct of the men with whom I have been brought into contact. Hitherto the management of the men has not in any way been harassed by the Union, their rules, or their Executive.

The increase in the cost of manual labour in the carbonizing department opens up a field for the introduction of machinery. The Ross system of mechanical stoking, which was introduced at Nine Elms some years since, was abandoned for the time, for the reason that, with the wages then paid, a very small saving was experienced in the work done by the machines. Another reason for their abandonment was that the work of charging was not so well performed as by hand. Recently, great improvements have been made in this system, which is in successful operation in America, and which it is intended to incorporate with the machines at Nine Elms. These alterations being effected, it is anticipated that a renewed trial of their work will result in considerable saving.

With regard to the general introduction of machine power for carbonizing work, I am strongly impressed with the fact that it would never answer to depend exclusively upon machinery. The nature of the work necessitates considerable wear and tear, and breakdowns are of frequent occurrence. Before they can be put right, considerable interruption is entailed in the production of gas—a condition of affairs much to be avoided. Machine work introduced into a works to an extent sufficient to take up the extra manufacture during the winter months, is the limit I am disposed to recommend. The use of machinery to this extent would in a great measure dispense with the necessity for engaging the migratory winter hands. These men, from my experience, form the nucleus of the causes of most of the trouble which occurs in the retort-house. They possess no interest in their employers, and are a very different type of men to the regular or summer hands. These men would experience a relief at the severance of connection with those who, from lack of interest in their work and their employers, fall into error, and brand the whole with an unenvied reputation.

Thus it would be well for gas companies if they could, by the introduction of sufficient machine power, afford enough employment throughout the whole of the year for a certain number of regular men. Men in the regular service of a company would hail with pleasure the introduction of machinery on these lines. On any other lines, I fear its introduction would be a sore point with many, and would probably remain so.

Systems of inclined retort-settings have during the last twelve months created quite a flutter of excitement in the gas world; and in several works installations have been made. At Nine Elms the system of the Coze settings has been introduced on a practical scale; and I was hopeful of being able to lay before the members an interesting account of their behaviour, which I regret I am precluded from doing owing to the unavoidable delay in the completion of the work. I have, however, had a portion recently under fire, and have made some gas in the house. But, as is generally the case with the introduction of a new system, inseparable difficulties crop up; and although they may not be of a serious character, some little time is necessary before the work can be sufficiently perfect to report upon. Consequently, as yet I am unable to speak authoritatively on this system.

Distribution.—The year 1890 will be chronicled as one noted for the number of the persecutions instituted by the London County Council for alleged deficiencies in the quality of gas supplied to the Metropolis. With the knowledge the officers of the Council possess (who are responsible for these persecutions) as to the untrustworthy character of the standard candles used for determining the illuminating power of the gas supplied, one would imagine that they would have hesitated before taking action against the Companies. It is common knowledge that the Chemist to the Council is the principal adviser in these matters; and his publications of the experiments he has made on the unreliability of the sperm candle are too well known to recapitulate. With these facts before us, the matter of these prosecutions has a strong taste of inexplicability.

Again, the County Council—the guardians of the welfare of the inhabitants of the Metropolis—forget that, by harassing the Gas Companies with these persecutions, they have caused the expenditure of large sums of money for the use of cannel coal to enrich the gas supplied—with the result, in one case at any rate, of contributing to the necessity of the recent increase of price, and for which the public will have to pay. Not only has the large use of cannel been necessary to attempt to attain the statutory requirements, and which in so many cases, according to the view of the County Council, have failed, but the usual make of gas per ton, of 10,400 cubic feet, which was maintained by The Gaslight and Coke Company up to the end of 1888, has gradually been reduced, and the year that has just closed will record a make per ton of very little over 10,200 cubic feet. It is idle to attribute this falling off in gas produced per ton to any other cause than the enforced restrictions as to the quality of the gas made. The quality of the coal used cannot be fairly taxed with being the cause of the reduction; for it is unlikely a change in its quality could occur so suddenly. It means, and does exemplify, that there is a limit to the yield per ton of this recently-created 16-candle coal gas. In this way also will the revenue accounts of the Metropolitan Companies be taxed, which will have the natural tendency of making dear gas.

That the necessity of being compelled to make gas of this quality exists, is a doubtful question. It must be remembered that with the new photometer, 16-candle gas is half a candle higher than with the old one; and, in order to steer clear of the vagaries of the candle, this has to be increased another half-candle. There is no wonder then, that the public complain of the dirty gas; and if this quality is forced on the public, gas-burner and lamp makers, will have to introduce another type of burner, and will have to re-adjust the air supply to their regenerative lamps. The principle of reducing the pressure to the least possible amount at the point of ignition, will, I fear, have to give way to the old-fashioned type, if clean public lamps in our streets, and white ceilings in our rooms, are to be desired.

And now, gentlemen, my task is nearly finished. I have ventured to lay before you a few notes of my experience in gas making, which I hope may prove interesting to at least some of the junior members of the Association. I am aware we have members enrolled whose experience is greater than my own, and whose position in the world of light is far higher than I have yet attained. To those members, I would make my apology for inflicting upon them the well-worn topics on which

I have touched. The matter of the preparation of an address is a difficult one now-a-days; for we have such a number of Associations, and each one must follow precedent and annually record its Inaugural Address. This has occurred to others, and will re-occur in future, unless the fortunate President *in embryo* may perchance have some special subject turn up for his benefit, and on which he may concentrate his attention. So far as I have undertaken my task, I have avoided reference to any subject on which I have not had personal experience. Our literature devoted to the gas industry is so well conducted, and passing events are chronicled with such care and accuracy, that there is no excuse for one being without full information of everything that transpires; and here lies my excuse for confining my observations within the compass of my every-day experience.

It now remains for me to convey to you my appreciation of the honour you have conferred on me in making me your President for the year; and I trust, with the co-operation of the Committee, that the interests and useful work of the Association will receive as much attention from the Executive in the future as in the past. Gas Associations are many; and I hope the Southern Association will vie with the best of them in collecting and disseminating useful knowledge among its members. To effect this will be my aim; and I hope I may rely on the members to assist the Executive in this work, by offering a sufficient number of papers for discussion, so that the proceedings of the year will equal, if not eclipse, any that have preceded it. I have the pleasure to congratulate the members on the continued success of the Association. Our numbers are steadily increasing; and our financial matters are in a satisfactory condition. Our meetings are, and have been, of a profitable nature, and above everything else have been characterized by the good-fellowship which invariably exists. Long may this continue.

Mr. E. BAKER (Reading) proposed a vote of thanks to the President for his admirable address.

Mr. J. ELDRIDGE (Oxford) seconded the proposition, which was carried with applause.

The PRESIDENT briefly acknowledged the vote, and the proceedings closed.

The members subsequently dined together.

MANCHESTER INSTITUTION.

ANNUAL MEETING, FEB. 28.

This Meeting—the twenty-first in the existence of the Institution—was held at the Grand Hotel, Manchester. Mr. W. W. Hutchinson, of Barnsley (the retiring President), occupied the chair during the opening proceedings.

Minutes of Last Meeting.

The Honorary Secretary (Mr. S. S. Mellor, of Northwich read the minutes of the last meeting, held at the Memorial Hall, Manchester, on Nov. 29, 1890; and these were confirmed.

New Member.

Mr. W. Severs, Manager of the Lymm Local Board Gas-Works, was elected a member of the Institution.

Report of the Committee.

The Secretary next read the annual report of the Committee, as follows:—

The Committee, in presenting the twenty-first report, have much pleasure in congratulating the members on the continued success of the Institution, and on the fact that it has, during its existence of 21 years, been the medium of eliciting and recording a mass of valuable information, thereby advancing the profession of gas engineering, and very materially benefiting the general public.

Four new members have been elected during the year. The Committee regret that one member—Mr. C. L. Hartley, of Middleton—has been removed by death since the last annual meeting. He will be much missed by those who knew him well. Three cease membership under Rule 1; and three under Rule 17—leaving 91 on the roll of members.

The opening meeting of the year was well attended, when the President gave a very interesting and instructive address. The adjourned discussion on the "Dinsmore Process" was taken, when Mr. Isaac Carr gave a supplemental paper, which provoked a very good debate.

The May meeting, which took the form of an excursion to Matlock and district, was very well attended. Haddon Hall and several places of interest were visited, under the guidance of Mr. R. Hall, Manager of the Gas-Works, Matlock, and a most enjoyable day was spent.

The third meeting of the year was held at Lancaster, in August, and proved very popular, as evinced by the exceptionally large attendance. The Corporation gas and residual products' works were visited under the guidance of Mr. Charles Armitage, the Engineer, who gave a description of the works and the results obtained therefrom. Lancaster Castle was also visited; and the various items of interest were especially well explained by Mr. Roper, Deputy Town Clerk of Lancaster. The members then adjourned to the Council Chamber, which the Mayor had kindly placed at their disposal. The thanks of the members are due to the Mayor, for his hospitality on the occasion, and for his kindness in placing the room at their disposal. The discussion of Mr. Newbigging's paper, on "The Utility of Water in Gas Manufacture," read at the previous November meeting, was then taken. Mr. G. E. Saville, of Todmorden, read a useful paper, on "A Combined Washer, Tar Extractor, and Exhaust Regulator." At the close of the meeting the members and friends were conveyed to Morecambe, where they took tea together. The thanks of the members are due to Mr. Armitage, Mr. Duff, and other gentlemen, for their efforts in promoting the success of the Lancaster meeting.

The November meeting, which was held in the Memorial Hall, Manchester, was (in consequence of the severe weather) only moderately attended. Mr. T. O. Paterson, of Birkenhead, was unanimously elected President for the ensuing year. The paper by Mr. G. E. Saville, read at the previous quarterly meeting, was then discussed. Mr. W. R. Chester, of Nottingham, contributed a valuable paper on "The Supply of Steam to Regenerator Furnaces," which was fairly well discussed. Mr. W. Gadd, C.E., of Manchester, gave "A Physical Demonstration of the Forces required to resist Wind Pressure on a Gasholder guided from the Base." A discussion having taken place, Mr. Thomas Newbigging, C.E., of Manchester, read a paper on "Lime Burning;" and, by consent, the discussion was adjourned.

The thanks of the Committee are due to those gentlemen who have so ably supported the Institution by contributing papers; and they trust that other members will, during the coming year, offer to follow their good example.

The Committee, in submitting the statement of accounts, are glad to be able to report that the balance standing against the Institution is now discharged, and that there is a small balance in hand. The unpaid subscriptions are also very much reduced; only five members being in arrear.

One of the members of the Committee, Mr. W. Woodward, has resigned during the year; and his place on the Committee has been filled up by Mr. John Cockcroft, of Littleborough, one of the oldest members of the Institution. The members of Committee who retire by rotation are Messrs. Chester and Dalgliesh.

The question of the most efficient method of discussing any papers read will engage the attention of the Committee during the coming year.

W. W. HUTCHINSON, President.
SAML. S. MELLOR, Hon. Secretary.

The statement of accounts was also presented.

On the motion of the PRESIDENT, seconded by Mr. T. O. PATERSON (Birkenhead), the report and accounts were adopted.

ELECTION OF OFFICERS.

The next business was the election of officers. Mr. C. Armitage (Lancaster) was elected Senior Vice-President; Mr. W. R. Chester (Nottingham), Junior Vice-President—a proposition by

Mr. A. Shires, of Biddulph, that Mr. J. Booth, of Southport, should be chosen for the latter office, falling to the ground for want of a seconder. Mr. T. Newbigging was re-appointed Treasurer; and Mr. S. S. Mellor, Hon. Secretary. Mr. W. Duff, of Morecambe, and Mr. W. S. Haddock, of Warrington, were elected members of Committee; and the retiring Auditors (Mr. W. Smith, of Hyde, and Mr. J. M'Kenzie, of Wilmslow) were continued in their office.

Introduction of the New President.

Mr. Hutchinson said the time had now arrived for him to resign the honourable position of President, which the members were pleased to confer upon him twelve months ago. In one sense it was a pleasure to retire from the office, for it had been onerous in many ways. It was satisfactory to him to give way to one in whose hands the interests of the Institution would be well cared for, and who heartily deserved their support. He was very pleased indeed to be able to acknowledge the fact that all the members had cordially co-operated with him in maintaining the high character of the Institution; and he trusted they would extend to his successor the kind consideration they had bestowed upon himself. He had now the pleasure of introducing his successor, Mr. T. O. Paterson.

The President-Elect, who was received with applause, then took the chair, and proceeded to read his

INAUGURAL ADDRESS.

Gentlemen,—Just twenty-one years ago, ten gentlemen intimately connected with our industry met in this great city. The primary object of that meeting was to present a token of respect and to bid an affectionate farewell to one we all know, one we all respect and honour—Thomas Newbigging. It is recorded in gas history that Mr. Newbigging left our shores for Pernambuco early in 1870; and it is also known that he has long since returned to us from that distant land, and that the force of his presence permeates throughout our system. To sum up, Newbigging is, so to speak, a medium through which we pass in the pursuit of our career. As the seed-bud of the Manchester District Institution of Gas Engineers was discovered on the occasion mentioned, I think it will be of interest to members generally to give here the record of the first proceedings on Feb. 26, 1870. Therefore I cannot do better than quote the words written at the first meeting:—

> After the business of the presentation, a unanimity of feeling was expressed by the gas engineers present as to the desirability of their being enabled to meet more often together for an interchange of thought, and to

discuss any matter appertaining to gas manufacture and distribution. The gentlemen present at this meeting formed themselves into a Provisional Committee to establish "An Association of Gas Engineers" to be held in Manchester, to be comprised of gas engineers and managers of gas-works situated within a certain radius of Manchester. The following is a list of names and offices of the gentlemen present at the meeting, and appointed to establish the Association: Joseph Wood, Chairman; Wm. Longworth, Secretary (pro tem.); Harrison Veevers, Robert Dempster, Isaac Kelsall, Wm. Smith, Wm. Blackledge, John Booth, James Braddock, David Brandwood. The Secretary was requested to draw up a circular stating the object of the Association, and to forward a copy of the same to each of the neighbouring gas engineers or managers. The name proposed to be given to the Association to be determined upon at a future meeting; but for the present, and until alteration, the Association shall be styled "The Manchester District Association of Gas Engineers." The first general meeting to take place immediately after the replies to the circular have been submitted to the Provisional Committee.

The foregoing is a complete extract of the business transacted by the Provisional Committee at their first meeting. On March 12, 1870, they again met to consider the replies received by the Secretary; and it appears that twenty gentlemen had written, signifying their intention to join the new Association. Rules were drawn up at this meeting, to be submitted for approval at a general meeting; and the Secretary was instructed to forward a copy to each member. The first general meeting was called on the 26th of March, when the report of the Provisional Committee was read and adopted. At this stage the "ship" had, it may be said, fairly left the builder's yard, and was under way; therefore I will not detain you much longer on matters of history. But before proceeding to other subjects of moment and of recent date, it is well to note two important resolutions carried at subsequent meetings. At a quarterly meeting held on Aug. 25, 1877, a resolution to the following effect was adopted: "That in future the title of this Society shall be known as 'The Manchester District Institution of Gas Engineers.'" A still more important change was made at the annual meeting held on Feb. 23, 1878, when it was resolved—"That the Institution shall consist of resident engineers or managers of gas-works in the employ of gas companies or corporations, and of gas engineers solely employed as consulting engineers, and not engaged as agents for any trading or manufacturing firm." The nature and power of the latter resolution is peculiarly significant at the present time; and our lasting thanks are due to Mr. Harrison Veevers for bringing forward such a resolution, and carrying it to a successful issue.

Now, gentlemen, I have cordially to thank you for the honour you have been pleased to confer upon me in electing me to the office of President of your Institution in the twenty-first year of its existence. I am but a young man in the ranks of the profession; and there are many who have a prior claim to that honour, and who are better fitted, from their longer experience, to guide the discussions of these meetings. The Institution has been distinguished from time to time by the valuable addresses of its Presidents, and the no less valuable papers of its members, which have proved in many instances, not only of general interest to the profession, but also of public benefit. The prosperity of the Institution up to the present time has been very satisfactory. The roll of membership has steadily increased; and at the present time the number is 92. Notwithstanding this, the question has often occurred to myself and to others: Are we deriving the fullest possible benefit or value from the power of the Institution? To my mind, we are not. By examining the Board of Trade returns, it will be found that we represent about £10,000,000 sterling of capital employed in our various undertakings; and although with that money we manufacture light, it must be admitted that we are ourselves in semi, if not in utter, darkness in many respects, and are simply feeling our way. Cannot, therefore, the forces of the Institution make an advance still further, and grapple with important debateable subjects in a more practical and exhaustive manner than any one individual member can be expected to do. It is no doubt true that we are unable, with our present finances, to enter upon a thorough system of theoretical and practical experiment to clear away the mystic "ifs" and "whys" which present themselves; and it may fairly be said that it is not incumbent upon us to do so. Should we, however, resolve to institute inquiries from time to time on concrete subjects, where is the "inevitable" to come from? I say, without reserve, that it should come from the companies and the corporations under whom we serve, as they must directly benefit from the inquiries instituted. The total cost for experts would be the amount paid for their services, *plus* printing, and less received for sales of results to other undertakings throughout the country, and I may say throughout the world. Should these results be of a searching and thorough character, the income on the sales would go largely towards balancing the account. I do not propose that boards and committees should be asked to contribute an annual fee to the Institution; far from it. My object is to take up a given subject at any time, and, if possible, exhaust it; the cost of the inquiry being borne by the undertakings on the books of the Institution. Take as an example petroleum oil as an enricher of gas. What a comfort it would be at the present time, to those who are struggling under heavy cannel prices, if they could commence with confidence to use oil as a substitute, in a scientific and at the same time practical manner. Standard data on many points are required; and I believe much might be obtained somewhat in the way suggested. There is another point I may mention here, and that is the issuing of monthly or quarterly returns, giving the current prices of secondary products obtained by the members. Such information I believe would prove useful, both when received and afterwards for a reference.

In preparing an annual address, one naturally first tries to discover what is our position to-day; and, when this is done, to place it in a progress-balance against our position last year, and note the gain or loss. To-day it is not my intention to inflict upon you such minute acts of cruelty, but rather to take a casual glance along the line of events of the past year.

It may be said that in most manufactories the price of raw material governs, to a large extent, the balance of profit on the undertaking; and in a gas manufactory no exception can be taken to the rule. Coal and cannel must be bought, and gas produced under all circumstances and at all times, whether it is produced at coal-famine rates or the reverse. There has been a steady advance in the price of coal since 1888. At that time the pit price for Arley Mine coal was 6s. 9d. a ton; and in 1890 the price had advanced to 9s. 10d. for the same class of gas coal —showing an increase of 45 per cent. These advances, we all know, are chiefly due to disturbing influences emanating from an unknown value—viz., the fair labour and fair pay of a collier. There appears to be no indication of a fall in prices, although some authorities think a decline will come before long. It is therefore beyond our power to do more in these matters than trust to good firms to put us on their most favoured terms when obtaining tenders.

With regard to residuals, we stand more in the position of colliery proprietors, inasmuch as we have something to sell. But even here we do not always obtain a fair market value. As an instance, last year a corporation invited tenders for tar. Three offers only were received; and the highest tender was 23s. 6d. per ton. Whether or not this price represented the market value, I leave each gentleman to judge; but I certainly am of opinion that it did not. In bygone times it was frequently urged that gas undertakings should proceed no further than the manufacture of gas, and should dispose of all their raw residuals. Gradually sulphate of ammonia forced its way forward; and at the present time a large percentage of gas-works carry on this branch of industry, and at a handsome profit compared with the old system. Tar distillation has made less progress, due probably to the process being somewhat dangerous, and more complicated in its manipulation than the treatment of ammoniacal liquor. But it may be asked, Why multiply tar distilleries? Is it not quite possible and perfectly reasonable to say, Let companies and corporations within a given area join together and erect large works and send their tar to be manufactured, sharing the profits according to the tonnage of the tar sent in. With respect to tar and ammonia products, there have been no changes of importance in the prices of these during the year, although I suppose manufacturers have a balance in their favour, notwithstanding a decline in the price of sulphate of ammonia.

Now for a few minutes let us consider some of the most important questions uppermost in the minds of gas engineers and managers in the conduct of their various works. Inventions and schemes come so rapidly into view in these days of high pressure, that our time scarcely admits of even a casual examination of the merits or demerits of a large number of them. But there are some which, when looked into, have a more lasting effect—tending to make us go back again and again, to think over or work out an idea. One such discovery is that of Mr. Claus, where he takes up an impurity in gas and applies it in such a way as practically to remove all other impurities usually extracted by lime and oxide of iron. Assuming that this process can be successfully mastered, and moulded into practical shape, we, when making coal contracts, practically buy all the materials necessary for producing and preparing the gas for the consumer. Since Mr. Charles Hunt contributed to The Gas Institute, in 1886, his valuable paper on this subject,* giving, as he did, minute details of the long series of experiments conducted at the Windsor Street Gas-Works, Birmingham, the Belfast Gas Department have tried the system on a large scale. As the experiments on which Mr. Stelfox is engaged are not yet completed, we are not in a position to form any estimate of the value of the process.

We have also before us, in active operation, the system of purification in which the use of oxygen plays a most important part. Mr. Valon, of Ramsgate, to whom we are indebted for the earliest information on the subject, states that by the proper use of oxygen—*i.e.*, using 0·1 per cent. by volume of oxygen for every 100 grains of sulphuretted hydrogen per 100 cubic feet of gas, or 1 cubic foot of oxygen for every 1000 grains—he is able to remove all the sulphuretted hydrogen and carbonic acid, and reduce the sulphur compounds to 6 or 8 grains per 100 cubic feet of purified gas. Mr. Valon also claims for this process a very much reduced lime bill; as no less than one million cubic feet of gas have been dealt with by the use of only two cubic yards of lime. These figures point to a large saving in new plant; and in those works where the plant is becoming overtaxed, a ready relief is offered by trying the oxygen process. In illuminating power, a rise of 5 per cent. on coal gas is stated to result. It would interest those members who manufacture 20-candle gas to know whether or not this 5 per cent. holds good. Altogether, the inception of this process seems to be soundly based, and to carry with it a stamp of genuineness. Mr. Belton, of Shrewsbury, speaks favourably of the process, though he expects to obtain still better results.

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* See *Journal of Gas Lighting*, Vol. XLVII., p. 1181.

The new discoveries in purification which I have briefly noticed have each concentrated in them a worth which must prove beneficial in the end; so that if, in gaining that end, although the first costs are large, the results should be measured not only by economies, but also by the value of total abolition of nuisances which in some towns have at times resulted in serious litigations.

In connection with manufacture we have the Dinsmore invention. It is now well known to all that the Dinsmore Company lay claim to the discovery of a process whereby they are able to manufacture from 20 to 21 candle gas without the aid of expensive cannels to attain this high quality. This subject has had a fair share of attention from men possessing the highest abilities in matters appertaining to gas; but, notwithstanding the fact that searching examinations and tests have been made by these gentlemen from time to time, there is undoubtedly something yet unexplained and undiscovered in the process, otherwise uniformity of success would obtain to a greater degree. I believe the same success attends the working at Widnes as heretofore; therefore all that can be said is that Mr. Isaac Carr must have discovered the missing link.

In continuing the important subject of carburetting poor gases, it must not be forgotten that the cannel coal beds in

England are now being worked exceedingly heavily. The tendency during the past twenty years has been to increase the illuminating power of gas beyond the normal amount yielded by the best gas-producing coal; thus necessitating a general use of cannel. It appears that the primary cannel of Wigan King coal is largely exhausted. The cannel of the Wigan four-feet coal has only been worked for a limited period, as its value was not known until it was examined by my father in 1876. But since that date supplies have been extensively drawn; and as the area of this deposit is comparatively small, we cannot expect a very lengthened supply. The curley cannel of North Wales can only be obtained in minute quantities in comparison with the demand. Yorkshire and Derbyshire, we are told, are still rich in cannels; but in both cases cannels of the first order are absent—the beds consisting of what may be termed second-class cannels. To prevent any possible misunderstanding regarding this statement, let it be understood that what I mean by "first order" is the cannel of the Wigan four-feet coal, or a similar quality. In Scotland several of the old standard seams have disappeared, and others are being increasingly drawn upon from year to year. The owners of cannels are no strangers to the limited supply, and hence the excessive prices to which they have been advanced; and one of the problems of the day is to find a substitute.

Mr. Frank Livesey and other gentlemen have turned their attention to oil as an enricher of coal gas; and for this they deserve the thanks of the profession. It is not my intention to make many remarks upon this interesting subject, or to exhaust your patience further than to refer briefly to one or two points. Mr. Livesey's experiments show that by using a mixture of gasoline and crude spirit of naphtha, in about equal parts, he could, by vaporizing with steam, raise 1000 cubic feet of gas from 16 to 17 candles, at a cost of 1½d. to 2½d. for oil; giving a net cost of 1¾d. after deducting ¾d. for the value of the gas made from the oil. To obtain the same results by the use of cannel, he found the relative cost to be nearly 2½d.; thereby showing a saving to the extent of ¾d. in favour of oil. It appears that during the experiments a trial was also made to prove whether or not the vapour carried by the gas was of a permanent character; and, in order to determine the matter, a quantity of coal gas was raised 2 candles, and allowed to stand for five days, when, upon testing, it was found to be of practically the same illuminating power. These experiments are valuable, inasmuch as they tell us at once that we are not entirely dependent upon collieries for cannel. They, however, only introduce the subject to us in a businesslike manner; and it now rests with ourselves to proceed further on the lines indicated by Mr. Livesey in his experiments, or as practice may otherwise lead us. Professor Lewes has placed a store of information within our reach upon the subject of oils; and I doubt not that he will be largely drawn upon in our pursuit for a good substitute for cannel.*

Then, again, it may be said that this question of oil is nearly allied to water gas. Upon this I only wish to say a few words. Although we hear a good deal about water gas in this country, it has, with slight exceptions, only so far amounted to talk. But when we read statistics of what is done, and is being done, across the Atlantic in the supply of water gas—statistics that show a wonderful growth within a few years—it certainly suggests to our minds the question whether we shall not be justified before long in putting down, at least partially, water-gas plant as an auxiliary to our ordinary plant in mid-winter. Large volumes of gas can be produced and carburetted within a small area; and in a gas-works, where incandescent coke is ever at hand, a generator could at any time be put into full operation within a few hours. In this manner it appears to me that we could carburet with cheap petroleum, and, by afterwards passing the gas through a superheater, produce a cheap, and at least a brilliant gas to help us out of a temporary, and possibly a serious difficulty. The cost of petroleum, upon which the light depends, must inevitably be much greater here than in the country which produces it. But, on the other hand, our economical means of producing the gas must, to a considerable extent, tell upon the cost price in the holder. Another leading feature to be kept in view in these times of labour troubles is our position. Would it not be very much strengthened at the weakest and most important part of the year if we were in a position to start a water-gas plant?

As we are discussing the producing section of a gas-works, let us look for a few moments into our retort-houses, and note the change of to-day as compared with ten or twenty years ago. If it is a moderately large house, we shall probably find smart work going on with our friend West's hand-stoking machinery. Note the condition of the men. They appear less fatigued, happier, and more capable of executing their work; and I am constrained to say that the working expenses, as given to me by a gas engineer well known to all of us, go to substantiate the observations I have noted down from time to time. With regard to power-stoking machinery, I can speak from past experience that the saving in fatigue to the men employed was very marked; but the saving in respect of the Corporation was also very marked—and I may say generally marked on the wrong side of the ledger. Now, however, we witness a different condition of affairs. Wherever a retort-house contains (say) from 130 to 150 mouthpieces in range, together with fairly regular work throughout the year, very clear advantages accrue from the adoption of power machinery; and it may also be said, without contradiction, that modern retort-house interiors wherein machinery is used contain a steadier class of men, who present an appearance less like Robinson Crusoe than those "in the old time before them." The results of labour disputes, among stokers especially, during the past two years have certainly armed us with arguments which certainly did not before exist in favour of machinery. These labour troubles have also brought into being the novel idea of placing retorts on an inclined plane. How far this change in the retort-house is going to place us beyond dependence on skilled stokers, has yet to be determined; but the results so far are encouraging in many respects. Regenerative settings are another great improvement introduced within late years. This subject is one of the most important that we have to deal with, and in itself presents materials for an address, without touching any other branches of our profession. For this reason I do not intend to detain you with any arguments of mine, beyond saying that during the past six years I have had regenerators attached to settings wherever possible.

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* Particulars of Mr. Livesey's experiments will be found in the "Reports of Gas Associations" for 1890, p. 321; and the information furnished by Professor Lewes is contained in the third of the series of Cantor Lectures delivered by him before the Society of Arts in December, 1890, and reported in the *Journal of Gas Lighting*, Vol. LVI., p. 1240.

New departures from what might be termed accepted necessities in the construction of gasholders have also been taken. It is now proved beyond doubt that it is not absolutely necessary, for the safety of a holder, to erect columns or standards of any description. Practical proof of this is to be found in Manchester, where a third lift has been added on the wire-rope principle, the invention of Mr. Pease, to a gasholder 100 feet in diameter. And at Haslingden a two-lift gasholder 80 ft. 9 in. in diameter was erected in 1889 on the same principle. The reports received regarding the working of these holders are most satisfactory. At Northwich, a telescopic holder erected upon the principle discovered by Mr. W. Gadd, has been in daily action for upwards of twelve months. In this case the guidance and rigidity of the vessels are maintained from the bottom curbs. Mr. Mellor, our Secretary, reports that, under all conditions of weather, the holder has worked equally well, and has not caused him any anxiety whatever. Judging from examples already existing, there is good evidence to warrant at least 30 per cent. reduction in future in the cost of holders.

Before concluding, it may be of interest to mention a few facts concerning the progress made in Birkenhead relative to gas-stoves. This branch of our business was commenced in June, 1883; and it was intimated to all consumers that sample cooking and heating stoves and utensils could be seen and full particulars obtained, in the show-room at the Gas and Water Office, where a number of stoves and fires were connected. Up to 1884, comparatively few cooking-stoves had been let out, although a fair business had been done in gas-fires. In March, 1885, a gas exhibition was held in a hall in the town. Lectures were delivered by Mrs. Thwaites and Mr. T. Fletcher; and the advantages of using gas for cooking and heating purposes were brought prominently under the notice of the townspeople. The result was very satisfactory; and a demand arose for stoves which has since been more than maintained. At the close of our financial year in March last we had 320 stoves out on simple hire, 210 on hire-purchase, 160 for which the hire-purchase had been completed, and 70 sold outright—in all, 760 stoves; and 550 gas-fires had also been sold during the same period. The usual opposition from townspeople, supported by some members of the governing body, had to be met. The conditions of sale, &c., are as follows: Gas-fires are sold at 25 per cent. profit; time and materials for fixing charged at cost price. Cooking-stoves are sold outright at 22 per cent. profit; time and materials for fixing included in the price, which will rather more than cover the cost. Stoves on the hire-purchase system are charged at cost price, with a margin for time and materials for fixing according to size; 2½ per cent. per annum charged for repairs during the period of hire, with interest at 4 per cent. on the balance at the end of each year of hire. Stoves are let out on simple hire at a rent equal to 12½ per cent. per annum on the cost of the stove and materials; and as we write off 10 per cent. per annum depreciation, and charge to the stove account the cost of fixing, removing, and repairing, this branch is worked at an apparent loss. As a set-off, there is the indirect profit on the sale of gas; and the stoves will eventually stand in our stock account at a nominal value. The hire-purchase stipulates that the amount agreed upon shall be paid by 20 equal quarterly instalments; and the hirer undertakes not to remove the stove, or allow it to be removed, during the period of hire without the consent (in writing) of the Corporation. If default is made in the quarterly instalments for a period of six months, the Corporation in addition to any other remedy they have, are at liberty to enter and resume full possession of the stove upon giving 24 hours' notice. The hire system has answered very well in Birkenhead. The majority of the stoves are let to occupiers of houses rented at from £20 to £40 per annum. There is very little difficulty in the collection of accounts; and business with this class of consumer is worth cultivating.

The following is an estimate of profit now made per annum owing to the increased sale of gas for cooking and heating purposes:—

760 cooking-stoves, at 20s. each per annum		£760
550 gas-fires, at 10s. each per annum		275
		£1035
Deduct interest on stock, £1929 at 4 per cent. .	£77	
Loss on stove account (including £66 attendant's wages)	111	
		188
		£847

This is exclusive of grillers, boiling-burners, &c. The day consumption on the two summer quarters before the introduction of stoves amounted to 10 per cent. of the whole; and it now represents 16 per cent. On the two winter quarters, the day consumption was formerly 26 per cent. of the whole; and now it is about 30 per cent.

Now, gentlemen, a few remarks about the electric light, and I will close. Some time ago, Mr. Alfred Clough, the Manager of the Liverpool Electric Supply Company, kindly accompanied me over the various electric stations now in operation in Liverpool, and explained in a general way the plant and working. The system in use in Liverpool is a direct-current continuous supply at a pressure of 110 volts. There are three systems now at work, containing plant capable of serving 15,500 16-candle power lamps; and the Company are at present supplying about 12,000 lights. The engines in use are Willans's central-valve compound, with cylinders 14 and 20 inches in diameter and with 9-inch stroke, capable of indicating 180-horse power. Ten are of the above size, and three with cylinders 10 and 14 inches in diameter, and with a 6-inch stroke, indicating 60-horse power.

The framework of the engines is constructed so as to form a complete chamber all but air-tight, and inside a supply of water and castor oil is always provided. This is churned up by the movement of the cranks, and effectually lubricates the internal bearings. The dynamos have magnets of the single-inverted horse-shoe type, with massive wrought-iron limbs. The armature shafts are coupled directly on to the crank-shafts of the engines. The battery of accumulators at each of the stations is capable of supplying 500 lights at a time; thus enabling the machinery to be stopped at from ten to twelve o'clock at night, and in some cases entirely on Sundays. The accumulators are charged during the daytime. All the distributing-mains of the Company are laid underground. The largest feeding-mains are composed of 91 No. 9 wires, and have a sectional area of 1·57 square inches. The conductor is covered with two layers of jute yarn and boiled in refined bitumen. It is next wrapped with parchment tape, and covered with a lead casing. The lead is protected by an outside covering of rough jute yarn treated with asphalte and tar. The ordinary feeders are made of 61 No. 11 wires, having an area of 0·6 of a square inch, and the distributers of 37 No. 13 wires, ¼-square inch in area. The service-lines to the consumers' premises are made of 19 No. 14 wires, insulated and covered with lead pipe. The length of frontage, along which distributing-mains are laid, is 9½ miles. The total length of single cable throughout the area is 41 miles; and the weight of copper employed in the mains is 210 tons. The light is generally used in offices, banks, hotels, &c., and in a fair number of shops; the latter taking it mostly for window-decoration—thus leaving the main lighting of the premises to be done by gas.

These few particulars regarding electricity in Liverpool bring my remarks to a close. I very much fear that the task allotted to me has been fulfilled in a very indifferent manner—that many interesting subjects have been entirely ignored, while others have been simply skimmed over. Of all this, I am only too well aware.

VOTES OF THANKS.

Mr. T. B. BALL (Rochdale) proposed a vote of thanks to the President for his Inaugural Address.

Mr. N. MEIKLEJOHN (Longwood) seconded the motion, and it was carried.

The PRESIDENT having acknowledged the resolution,

Mr. HARRISON VEEVERS (Dukinfield) proposed a vote of thanks to the ex-President for his services during the past year. In connection with their twenty-first anniversary, he might remark that of the ten gentlemen who were at the inauguration of the Institution exactly twenty-one years ago, it was singular that the first and last names on the list were those of deceased gentlemen—Mr. Joseph Wood and Mr. David Brandwood. Two had gone from them in the way of profession—Mr. Dempster and Mr. Kelsall, both of whom had gone into trade, and therefore became ineligible to continue as members of the Institution. With regard to the remarks of the President as to the change in the constitution of the Institution, he might explain that it was in connection with Mr. Newbigging that the resolution was carried. Mr. Newbigging was not an engineer in charge of any particular works, and wishing to include him in their number, they altered the rule so as to make consulting engineers not acting as agents for any trading firm eligible for membership. He mentioned this as a compliment to Mr. Newbigging, whose services were thought so valuable to the Institution that special means were taken to secure them.

Mr. T. Duxbury (Darwen) seconded the proposition, and it was carried by acclamation.

The Ex-President briefly acknowledged the compliment.

Votes of thanks were also accorded to the Committee, the Honorary Secretary, and to the Treasurer, for their services during the year.

Mr. Newbigging's Paper on "Lime Burning."*

The following discussion then took place on Mr. Newbigging's paper on "Lime Burning," read at the previous meeting :—

The President (Mr. T. O. Paterson, of Birkenhead) remarked this question was a very important one in some districts. As a rule, their members were within easy reach of lime, and perhaps did not require to know the why and the wherefore of the process of burning it. Still the paper was one which could always be referred to; and in this respect it was of considerable value. It went into the matter very clearly; and a little discussion might make it still more clear.

Mr. Harrison Veevers (Dukinfield) explained that he suggested the postponement of the discussion at the last meeting because he thought there was more in the subject than the mere question of lime burning. In a few remarks which he then made, he pointed out that lime burning ought to afford them a good demand for coke. North of Manchester, in the neighbourhood of Clitheroe, they used enormous quantities of gas coke for this purpose, and found great benefit from it. He had tried to introduce the practice south of Manchester, in the Derbyshire district; but the lime burners there were so wedded to the use of coal that he could not get them away from it, notwithstanding that the experience of Clitheroe was that coke was both better and cheaper. Another question was whether it was worth while to re-burn lime after it had been used for purifying gas, so as to use it over again, in districts far from the lime districts.

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* See "Reports of Gas Associations" for 1890, p. 386.

Mr. W. W. HUTCHINSON (Barnsley) observed that, although lime burning was still carried on very much as it was 300 years ago, they had a demand for coke for lime burning at Barnsley. There was likely to be a good sale for that purpose; for he was informed that gas coke, with the addition of a small quantity of slack, was the most suitable material. This ought to affect gas managers from two points—viz., the cheapening of the cost of lime, and the sale of coke.

Mr. T. DUXBURY (Darwen) said Mr. Newbigging's paper was chiefly descriptive, and did not contain very much debateable matter. He should have been glad if Mr. Newbigging had gone further into the question of the use of lime. They employed it in their purifiers to take out carbonic acid; and he should like to know whether lime used for that purpose had any deleterious effect on the illuminating power of the gas. Carbonic acid acted as a diluent, so to speak, of the illuminating power of coal gas; but the question was whether, in eliminating the carbonic acid, some of the illuminating power was not taken out of the gas. If gas could be manufactured without any carbonic acid in it, and a certain amount of carbonic acid were then added, it would act as a diluent, and no doubt reduce the illuminating power. If lime were then used to take out the carbonic acid, would the gas be of the same illuminating power as previous to the addition of the carbonic acid, or would not the lime tend to reduce the illuminating power of the gas?

Mr. R. HALL (Matlock Bridge) said he had had some experience of lime burning; there being some lime-kilns about 150 yards from his works. At this place they used roborite for blasting, and every now and then a shower of stones came over the works, and the men had to run under cover for shelter. It was certainly very singular that lime burning was for the most part carried on in the primitive way described by Mr. Newbigging. The Buxton Lime Company had put up some Hoffman kilns; but they also used open kilns. Other systems of lime burning had been introduced; but none of them seemed to make any great headway; and the lime burners were still going on with the old process which had been used from time immemorial. As to the fuel, the great thing was to get proper coal. Some kinds were most suitable, and others very unsuitable. Derbyshire was the greatest lime-producing county in the kingdom; and there were certain classes of coal produced in the county which served the purpose extremely well. What was wanted was a hard bright coal, giving off a white ash. The Pilsley, Pinxton, and Butterley varieties were considered very suitable for the purpose; the only economy sought in producing a clean lime being to get the right kind of coal. He believed there was a great opening for somebody to introduce new ideas of lime-burning; for it seemed absurd that they should still work the old barbarous system. He could not think the last word had been said on the subject; and he hoped some system would be introduced by which less smoke would be given off.

Mr. Newbigging, in reply, said he knew that the paper would not give rise to much discussion. It was not a debateable subject; but he thought a paper of this kind would be useful, especially to some young managers who went abroad. He was very glad that Mr. Veevers, Mr. Hutchinson, and Mr. Hall had supplemented what he said by some observations with reference to the use of coke. He wished Mr. Veevers had gone further, and ascertained the proportion of coke used—the weight needed per ton of lime—as he (Mr. Newbigging) did with reference to the consumption of coal for the purpose. This information might have appeared in the report of the discussion, and would have added to its value. Of course, he (Mr. Newbigging) might have gone further into the subject, and referred to the value of lime in gas purification, and the likelihood of its diminishing the illuminating power, as Mr. Duxbury suggested. There were other points he could also have touched upon; but he thought it better to keep to the subject in hand. It was not wise to wander away from one's subject. Mr. Duxbury had raised a very important question indeed, which might well be made the subject of another paper at some other time. Mr. Duxbury ought to tell them distinctly whether lime was or was not deleterious in its effect upon the illuminating power of gas. It would have been interesting if he had told them his experience; and it would be well for him to give them a paper at a future meeting on the subject. As to the remarks of Mr. Hall, it was a curious thing that the Derbyshire coal was the best for lime burning, and that it appeared in the district where it was needed. They often found these coincidences in Nature; and they were very interesting and remarkable. Mr. Hislop, he might remark, did not in his invention confine his re-burning of lime to that which had been used for extracting carbonic acid only. He also applied it to lime used for taking up sulphuretted hydrogen.

Mr. Veevers thought that an undue amount of sulphur collected by the lime would prevent the lime from being used for re-burning.

The President closed the discussion by remarking that the old barbarous way in which lime burning was carried on, must be very wasteful. The use of lime would increase in gas-works as the trouble with respect to sulphur compounds increased; and he should imagine that this fact would have an influence on the production of lime.

The members, and some friends, afterwards had dinner together; among the toasts proposed being that of the "Founders of the Institution."

MIDLAND ASSOCIATION.

ANNUAL MEETING, MARCH 5.

This Meeting was held at the Great Western Hotel, Birmingham—Mr. C. STAFFORD ELLERY, Engineer and Manager of the Bath Gaslight Company (the President), in thechair.

The HON. SECRETARY (Mr. J. S. Reeves, of Bilston) read the minutes of the previous meeting, and they were confirmed.

COMMITTEE'S ANNUAL REPORT.

The annual report of the Committee was then presented, as follows:—

Your Committee have pleasure in submitting the following report for the year 1890:—

At the annual meeting, held Feb. 20, the President, Mr. Henry Peaty, of Burslem, delivered his address, in which he reviewed the positions occupied by electricity, oil-lamps, and water gas as illuminants, in competition with coal gas. He also drew attention to labour combinations, and enhanced values of coals, as factors likely to lead to advance of prices for gas. The new systems of retort-settings, the diminished cost of purifying gas by Valon's method, as practised at Ramsgate, were severally noticed as measures likely to effect economies in the cost of gas manufacture. An instructive paper was read by Mr. Meiklejohn, on "The Recovery of Sulphur from Alkali Waste."

The Spring meeting was held on June 24, at Stoke-on-Trent, from which place the members were conveyed to Trentham Park, the seat of the Duke of Sutherland. A most enjoyable ramble was taken through the picturesque parts of the park; and the party afterwards returned to the North Stafford Hotel, where they dined together.

The third meeting of the year was held on Nov. 13, at the Great Western Hotel, Birmingham. The attendance was good; and an instructive discussion took place on Mr. Meiklejohn's paper on "Sulphur Recovery from Alkali Waste." Mr. J. T. Lewis read an interesting paper on "Weekly and Monthly Payments for Gas." The discussion on this paper was postponed till the next meeting of the Association.

The election of officers then took place. Mr. C. S. Ellery, of Bath, was unanimously elected President for the ensuing year. Mr. P. Simpson was re-elected Treasurer; and Mr. J. S. Reeves was re-elected Hon. Secretary. The other appointments were: Messrs. W. T. Tew and J. T. Lewis, members of the Committee. Messrs. C. Meiklejohn and W. W. Hulse were elected Auditors.

The members then visited the Swan Village Gas-Works, and inspected

Elliott's system of charging and drawing retorts; and subsequently a visit was paid to the Windsor Street works to see in operation a setting of inclined retorts. The members afterwards dined together at the Great Western Hotel.

Three members have been added during the year, and the Associaion has lost three by withdrawals, and one by the death of Mr. D. W. Lees.

The Committee consider that a fair amount of work has been done by the Association during the past year; but they trust that the ensuing year will be marked by a more ready response on the part of the members to solicitations to contribute papers, as in this way chiefly can the usefulness of the Association be maintained.

On behalf of the Committee,
C. STAFFORD ELLERY, *President.*
J. S. REEVES, *Hon. Secretary.*

Accompanying the report was the statement of accounts for the year ending Dee. 31, 1890.

On the motion of Mr. H. PEATY (Burslem), seconded by Mr. R. O. PATERSON (Cheltenham), the report and accounts were adopted.

NEW MEMBER.

The name of Mr. Thomas Davis, Manager of the Sandbach Gas-Works, was submitted by the Committee for approval; and Mr. Davis was duly elected a member of the Association.

ASSOCIATION REPORTS.

It was next resolved that the volume of "Reports of Gas Associations" for the past year should be supplied to all the members free, as hitherto.

THE PLACE OF NEXT MEETING.

The PRESIDENT said, with regard to the next meeting, he was pleased to state that Mr. Tew and Mr. Cross had very kindly offered the Association, through their Committees, an invitation to hold it in May at Warwick and Leamington. He had much pleasure in submitting a motion to this effect.

This was agreed to; it being left to the Committee to fix the day.

The PRESIDENT then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—The published reports of the several Gas Associations, which now form quite a small library, are becoming increasingly useful as books of reference. I have lately been tracing through their pages the course of the Midland Association. The many able addresses and papers followed by exhaustive discussions, which have been contributed by its members, tell a tale of devoted service; and there is no exaggeration in saying that the Association has a record of uninterrupted prosperity. Small wonder that to-day I experience considerable agitation on stepping into this chair. Gentlemen, I thank you for the honour you have conferred on me; but, sensible of my deficiency, I ask your generous assistance, in order that there be no break in this history of usefulness.

Permit me to congratulate you on having so well survived the experiences of the late severe winter. A short spasm of extra demand for gas by cold consumers in frosty weather, we enjoy; but quite another matter is it to endure the protracted throes of the many weeks during which gasholders developed an almost preternatural tendency to travel to their landing stones—when all the intricacies of plant and connections were subjected to a rarely experienced strain, and the material on the selection of which much care had been expended, had to be manipulated by labour not the most reliable. Such a season, which must be experienced to be appreciated, brings home forcefully the responsibility of our calling. We may also congratulate our employers on the business of such a season, especially those whose works are furnished for these exceptional demands.

One noteworthy feature was that so large a proportion of the increased consumption took place during the hours of daylight. A few years ago the diagrams taken at station-governors bore evidence to a desire to keep down the pressures in the distributing-mains from sunrise to sunset. The dominant thought of the manager was summed up in the expression "unaccounted-for gas." Now things are changed; and it is no extraordinary experience to find over 30 per cent. of the gas leaving the works in the daytime. The advantage of this higher duty done by the distributing plant is obvious; but now that mains are under heavy pressures for so many hours of the day, it becomes more than ever necessary to keep a vigilant watch for defects in mains and services, and to prevent practices which may entail loss of gas.

Since the severe frost we have discovered eleven broken mains in different parts of Bath. All the fractures, excepting one, occurred in small pipes, 4-inch and under, and where services were connected. Although some of these mains are 2 ft. 6 in. and more below the surface, I can attribute the breakages to no other cause than the prolonged and exceptional fall in temperature. It is evidence, if such is needed, of the advisability, where possible, of burying all pipes 30 inches deep at least.

One other exceptional experience has come to my notice. The street syphons contain an unusual quantity of water—in some cases showing strong traces of hydrocarbons. The severity of the weather has been far-reaching in its effects. I mention this, as it may assist some who have been puzzled to account for occasional irregularities in the quantity and quality of the gas supplied.

A word about station governors. Until late years, when trunk mains were enlarged it was usual to put down new governors of greater capacity. The expedient of making the same governor serve the larger main, by bye-passing a portion of the gas during the hours of greatest consumption, has been fairly tested; and after several years' experience, I am well satisfied with the result of this method of controlling the pressures, and curtailing the capital outlay in the governor-room. Cases have lately occurred where a district has been temporarily inconvenienced by mistakes at the works, in changing valves, or by accumulations of naphthalene in the outlet-pipes of gasholders. To provide against this contingency, we have adopted the suggestion of fixing a self-acting governor on the outlet of the station meters, and connected direct to the distributing plant, so loaded that, in the event of any accident happening, communication is at once opened between the inlet of the holders and the supply-mains.

After every care has been taken to maintain a sufficient supply at the consumers' stoves and fires, it not infrequently happens that complaints are made of the costliness of gas as a fuel. In too many cases there appears to be some ground for these complaints—mainly because of the absurd amount of heat allowed to waste up flues and chimneys consequent upon the unscientific setting of the appliances for using the gas. Architects and builders do not appear to give such consideration to the subject as I venture to think its importance deserves. When houses are built, one form or other of the coal-fire grate is still put in every room. By-and-by the inevitable gas-fire will be called for. This must then stand on the hearth stone—if not out in the room, or be more or less ingeniously attached to the old grate, according to the skill of the fitter or the whim of the consumer. We all must have been interested in reading the short discussion which took place last Monday in both Houses of Parliament on the smoke nuisance in London. No excuse surely is needed for pressing home on those who may be planning houses the necessity for anticipating the adoption of appliances for using gaseous fuel and making more perfect arrangements for utilizing what otherwise will be waste heat.

Another direction in which some improvement may be looked for, is the perfecting of contrivances in which the gas consumed may be used for the double purpose of light and heat. The syphon stove does this in a measure—as sometimes used in entrance halls; but the principle admits of large extension.

It is satisfactory to note the growing appreciation of gas as a "mode of motion." For work which until recently was done by living agents, the smaller sized gas-engines are being applied. Printers have long used them; but now provision dealers begin to find the economy of putting them to roast and grind coffee, crush sugar, &c.; merchants, to elevate and handle corn, flour, malt, &c.; contractors, to drive various kinds of labour-saving machinery; even sempstresses, to work sewing machines; and numerous trades, to their great advantage, are adopting them in premises and under conditions impossible to steam-engines. But it is still more gratifying to observe how the larger sizes are rapidly finding their way into the shops of our great engineering works—superseding steam; and thus bearing testimony to the economy and efficiency of gas as compared with solid fuel. Electricians are not slow to discover the power best suited to their work; and evidence is not wanting that electric light companies will find a most formidable rival in the compact plant of gas-engine and dynamo as now manufactured for private installations.

The cleanly, reliable, ever-ready gas-engine is clearly destined to play a more prominent part in commercial enterprise, as its real value becomes understood; and it behoves gas companies to keep in view the possibility of rival gas generators, on the score of cheapness, getting a footing from which it will be difficult to dislodge them.

Whether the demand for fuel gas will ever grow to such proportions as to render it remunerative to distribute two qualities, is a problem yet to be solved. But in these days, when cannel coal is less abundant, and the conditions under which the illuminating power is tested grow increasingly onerous, it does appear somewhat extravagant to spend large sums of money to enrich the gas produced from ordinary coals, which of itself is well suited for all purposes other than lighting.

The growth of business in these departments of heating and motive power has been so rapid, when compared with the older branch of lighting, that there appears some danger lest the one receives an undue share of attention, to the partial neglect of the other. The resolute appearance of rival illuminants (looking as though they have come to stay) may account for this; but I venture to urge that our first care should still be to merit and retain a foremost place as suppliers of light. It was not to be expected that a position such as that enjoyed by the gas industry, should go unchallenged. Nature is prodigal in her gifts, and scientific men are too active to permit any of her forces to lie untried. It is still true that "there is no one thing in Nature whereof the uses to human life are yet thereby understood;" and we do well to recognize the possibility of a continual accession to the power of our competitors in penetrating into "the Arcana of Nature," and becoming better acquainted with her laws. But the door is not closed to ourselves; and it may be that some of the very forces which at present are flaunted before us as irresistible rivals, may yet be pressed into our service, and made to minister to the greater success of the gas industry.

Before touching on one or two points which appear to call for attention, a few words respecting the advent and behaviour of the electric light in Bath may be of interest. It seems to be the opinion of many that a gas manager cannot form an unbiassed judgment as to any system of artificial illumination—that he suffers a sort of mental alienation in the presence of competition, and therefore any opinion he may express must be received with a very considerable amount of caution. This notwithstanding, I will venture a few words, having been favoured with a fairly good opportunity of learning something about this beautiful illuminant.

One of the first indications of the electric mains being charged was a disturbance of the action of our telephones. How far the telegraph and telephone wires will ultimately be affected by induction, is a matter (although of common interest) which so largely affects the Postal Authorities that it may safely be left in their hands to take such steps as may be necessary to safeguard other interests.

It is worthy of note how these enterprising but prudent electricians limit their area of supply to the most busy thoroughfares and best residential parts of a city. In Bath, about 81 arc lights have been substituted for some 350 gas-lamps. These lights are nominally of 1200-candle power; but this estimate it appears is based on experiments made with naked lights. The globes now used are said to reduce the efficiency by some 300 candles. Whether a light equal to 900 candles is regularly developed is a question which may some day be more definitely settled. For the present, those who are troubled with incredulous minds cannot agree with the estimate.

The above number of lamps was soon seen to be insufficient for effectually lighting some 7000 yards of the busiest streets. There are many dismal shadows between the lamps, even when all are behaving with electrical propriety; but when one or more get "groggy" [that, I fear, is not the technical term; but a word seems wanting to characterize that condition of instability into which the lights sometimes relapse], when this occurs the inconvenience is uncomfortably felt over a large area, and is a most serious objection to any system of lighting by means of high candle power lamps placed far apart. But further, since a 1200-candle power lamp cannot at present prices be placed at every corner, the cross-streets and courts are very dark by contrast with the more favoured thoroughfares. In the main streets the doorways not immediately adjacent to the electric lamps, are thrown into deep shadow, to the great inconvenience of householders and visitors. Of course, the number of lamps might be increased; but here the question of cost steps in. The present installation is estimated to increase the cost of public lighting by about 70 per cent., or, in round figures, some £850 per annum. Every additional lamp adds a further sum of £25 17s. 6d. per annum. A few more lamps interspersed to complete the present scheme, would bring the figures to a total for which in my opinion a more satisfactory effect might have been produced with gas.

For private use the light is effective, when a sufficient number of lamps are used. Consumers pay at "per lamp;" the charge for a 10-candle power lamp being about 12s. per annum. There are cases in which the number originally estimated for proved inadequate. But the light is uncertain, and complaints are not infrequent. Not long since its patrons were unexpectedly treated to a sudden brilliant effect—startling in its brightness, but alas short-lived. That extra current was the cause of much damage to lamps, and must have been a costly accident for someone to pay for.

The disadvantage under which the suppliers labour, in that they cannot store this subtle fluid, is frequently evidenced, to the inconvenience of consumers who must not object to occasional dimness. But they have shown great forbearance; and there is evidently a strong desire abroad to give electricity a fair trial.

The cost of installing the light in private premises is formidable; and those who commit themselves to the outlay have as yet no sufficient guarantee of what the subsequent expense may be for current, renewals, heating and ventilating appliances which must follow the introduction of the electric light, not mentioning the gas needed for those times of emergency which sometimes occur.

Whether the present charge for current will continue, is a problem for time to solve; also how far the business will be lucrative from a shareholders' point of view. The Bath installation is in the hands of the original promoter, as the capital to form a company was not forthcoming when the public was appealed to. But turning to the Taunton balance-sheet—that Company being the parent of the Bath installation—the figures should be a safe basis for calculation. For the year 1889 the gross profit was £352. The accounts, however, included the sum of £660, net profits on the "Bath installation." Taking the Taunton working, without what the Chairman calls "installation work," the figures look thus—

Loss on the year 1889 (in round figures), £308.
" " 1890 " " £438.

In the *Somerset Express*, Feb. 28, the Chairman is reported to have said, speaking of raising £6000 of debentures: "If this was not done, they would have to face the matter in the way of reconstruction;" and later in the same speech, when urging the shareholders to assist in extending the business, he expressed the hope that they would see their way to carry on the concern for twelve months. I refer to these matters to show that, unless helped by profits on installations, there is no present prospect of the charges for current being reduced.

Taking a dispassionate view of the present situation, there does not appear to be any need for deviating from the policy of paying proper respect to a formidable competitor, and applying every device that science suggests for the improvement and cheapening of the illuminant we supply. The tendency in these days is distinctly in the direction of brighter illumination in streets and places of business. The electric light has done much to bring this about; and for this reason it may be looked upon rather as a friend than a foe.

Much may still be done to popularize gas. The interesting paper read at our last meeting by Mr. Lewis (and which I trust will give rise to a free discussion to-day) approaches this subject on one side. I will not anticipate what may be said further than to remark upon the disadvantage of charging for gas at per 1000 cubic feet. Half-a-crown per 1000, and 3d. per 100, is much the same thing to the supplier; but to a cottager, who buys his oil by the pint, or even the small tradesman, who also prefers short reckonings, the system of charging at per 100 cubic feet, and frequent collection, would prove most attractive.

With the larger circle of consumers, gas would be more popular if improvements in one or two directions could be effected. The quality of heat which at certain seasons of the year is a recommendation, becomes a weapon of attack in the hands of the unfriendly, when the more genial days come round. Here is a field for enterprise. Ventilating lights are being introduced; and I am pleased to recognize the distinct advance made by Mr. Sugg in the experiments for inducing a current of air through an enclosed lamp, by means of which all products of combustion are conveyed away and the temperature of the room maintained pleasantly cool. But there is still room for improvement, both as regards efficiency and economy, in ventilating lights. Further, supplying pure gas does not seem to be sufficient; suggesting the most suitable form of lamp is not sufficient. What can be more unsatisfactory than the appearance of a regenerative lamp with choked passages and soiled glasses? The remedy seems to lie, at least to some extent, in gas companies, for a fixed charge, taking the maintenance of lamps into their own hands, or appointing agents to whom the duty may be transferred. Many tradesmen would gladly pay the trifling cost for such a boon, or for having burners cleaned or changed periodically.

The year 1890 will be remembered for the advances in coal, railway rates, and labour, coming at a time when the conditions for testing the gas were more than ever onerous, and when the markets for some of the bye-products were depressed. These increased charges bore hardly on gas-works, especially those accustomed to use local coals requiring a considerable percentage of cannel or other enricher. On the other hand, and no doubt caused to some extent by these adverse influences, retort-houses which for long years had changed in few respects save magnitude, now show the successful application of appliances for more economically handling material and producing gas.

The use of elevators and conveyors is coming into favour for the transport of coal and coke. The extension of this method of carrying material can be but a matter of time; and the difficulties ought not to be insuperable which at present seem to bar the way to the substitution of endless steel bands for barrows in receiving the coke direct from the retorts, and conveying it direct to waggons or to the coke-yard.

Inclined retorts are to be found in many works. The members of this Association present at the last meeting were much interested to witness the experiments of our respected colleague, Mr. Hunt, at the Windsor Street works. One distinct feature of his setting was that all the advantages were gained without costly structural alterations. Whether for medium-sized works it will not prove desirable to shorten the retorts, is a point for further experiment. The principle of setting retorts at an angle that shall minimize the labour of charging and drawing, must commend itself to all. The details may vary according to the arrangements of the works into which it may be introduced; but I feel sure I only express your feelings when I wish Mr. Hunt every success in the experiments he has undertaken, and when I request the favour of some further particulars at his convenience. It is one of the healthiest signs of the times that so many engineers are patiently pursuing investigations, and that committees and directors are ready to liberally contribute the funds necessary for such researches. The suggestion has been made, and cannot I think be emphasized too strongly, that companies and corporations should be asked to maintain a fund for the purposes of research, under a committee of engineers, so that all who reap the benefits may have an opportunity of bearing a proper share of the expense.

Regenerative furnaces have now established a reputation for economy and convenience; but some works are still fitted with open fires—not from choice, but because no system has been brought forward suited for situations where excavations are impossible on account of water.

Mechanical appliances for charging and drawing retorts must here be mentioned. The system under trial at the Swan Village works, with which you were at our last meeting made acquainted by the courtesy of Mr. Hack, is novel and interesting. It is, I am sure, the unanimous wish of this meeting that, when convenient, Mr. Hack will favour us with some further particulars. At Bath, West's system has been introduced. Two sets of hand-machines are found sufficient for sixteen beds of through retorts—seven retorts in each bed. Thus each set of machines does all the work of 112 mouthpieces. The coal is emptied from railway waggons direct into breakers; and raised by means of elevators to overhead hoppers, which feed the charging-machines. I find it necessary to load the second scoop lighter than the first; otherwise some coal is drawn back on the mouthpiece, and even when backed up it does not burn off in the time allotted. One disadvantage is that the wheels of the charger have a tendency to cut the floor of some retorts. This may be met by making the floor of the retorts thicker. In other respects—especially when the labour is considered—it must be pronounced a success. From what I have seen, I am inclined to think that Mr. West (who has done so much to perfect stoking machinery) might readily adapt some sort of tipping scoop to his plant, thus making it of service in houses furnished with inclined retorts.

Water gas is another of the subjects receiving special attention just now, and of which much will be heard in the near future. My experience of petroleum as an enricher was independent of any water-gas plant. Various methods were tried. The oil was pumped into the retorts, and then poured into a funnel at the end of a tube passing through a ¾-inch hole in the lid, and back some 10 feet into the retort. But the best results were obtained by running a small stream continuously into an iron retort, collecting the gas in a small holder, and drawing it to the exhausters as required. It is difficult to prevent or discover waste when the oil is mixed with the ordinary charge of coal or coke; and any excess of heat at once breaks up the hydrocarbons, choking the pipes with soot, and increasing the cost of working.

The removal of the tar from the hydraulic main is a subject that has attracted much attention. It may be of interest to mention a method I now have in operation, depending for its action upon the different specific gravity of tar and liquor. A tank containing a float, weighted to just sink in water, is connected to the bottom of the hydraulic main; and as the tar is made, it flows to this tank and actuates the float, which is connected by a rod and lever to a tap that is thus opened as the tar accumulates. The action is simple and effective. Now that the dip-pipes are sealed in water only, there is a tendency at times for this to evaporate. A buoy tank and tap are therefore fitted to the main; and the water-line is maintained by a regulating valve. This plan reduces the pressure in the retorts; but I have not found it a cure for choking ascension-pipes.

To lessen the amount of heat lost by radiation from the top of the benches, and which increases the temperature of the hydraulic main and connections, I have, with considerable advantage, tried the experiment of spreading a thin layer of slag-wool over the brickwork. This, covered with spent lime concrete, makes a very firm floor for anyone having occasion to walk over it.

One word in conclusion on the labour question. It would be useful and interesting if some statistician would discover the number of souls more or less dependent for a livelihood on the gas industry. If the vast army could be induced to consider how great is their interest in the issues at stake, we should hear less of strikes, less of unions and combinations against employers, and more of that feeling of amity which in years gone by so generally characterized the relations between those paying and those receiving wages. I am gratified to be able to state that my experience this winter augurs well for a return of the old-fashioned confidence. There are unfortunately some places where committees make the mistaken attempt to control the works in spite of the manager, where considerateness is conspicuous by its absence, with the disastrous results we see reported from time to time. But where more humane and prudent counsels prevail, and the men are encouraged to trust a manager whom they know to be invested with proper authority, and who uses his power with a righteous regard to the sacredness of his trust, I make bold to believe that the insidious counsels of a few agitators will again be treated with the indifference such folly deserves.

I conclude by venturing to express the hope that we may soon see prevailing a determination to offer a united front to the attacks of foes and rivals.

Mr. PEATY proposed a vote of thanks to the President for his address, which, he said, had been very instructive and interesting, and showed the wide range included by the industry in which the members were concerned.

Mr. PATERSON seconded the motion; and it was carried with acclamation.

The PRESIDENT briefly returned thanks, and asked the members to co-operate heartily in carrying out the work of the Association.

WEEKLY AND MONTHLY PAYMENTS FOR GAS.

The paper on the above subject read by Mr. J. T. Lewis, of Wellingborough, at the meeting held in November last year,* was then discussed.

Mr. E. H. MILLARD (Hinckley) said: I have been much interested in the subject of the weekly collection of accounts; and I am more than doubtful that the smaller consumers pay where the price is low—say, about 2s. 6d. per 1000 cubic feet—and the margin between the cost of production and selling price must consequently be narrow. I came from a place where the price was 2s., and there was no charge for meter-rents or fixing; and in a case like that there does not appear scope for weekly collecting. As I am now situated—paying nearly 1s. 6d. per 1000 cubic feet for interest and redemption of capital, and 4d. per 1000 feet for rates and taxes, and also being in a good position for increased output—I thought if I could get an increased consumption I should be able to make as favourable terms as anyone else was doing. I started to consider the subject; and I was much struck with the "sweet simplicity" of putting an additional price on gas to cover meter hire, cost of collecting, fixing meters, and fitting up the houses. When I came to calculate the cost, there were 52 visits to be paid in the year; and as a man can pay about 100 visits in a day, it works out to 2s. 2d. per annum. Cards and books cost 1d. per quarter, or 4d. a year. The average meter-rent in 20 towns is 10d. per quarter; and where special or prepayment meters are used, it would be more. These details run up to 5s. 10d. for the expenses. Taking the consumption as 8000 cubic feet, that came out at 8¾d. per 1000 feet; or if they had a consumption of 10,000 cubic feet, it worked out at 7d. I still require a fair working interest for providing pipes and fittings in the house, which would be 2d. (7½ per cent. on £1). There is a further outlay on the service, and extra leakage which we are all agreed is chiefly from the service-pipes. The average expenditure on repairs of mains and services is ½d. per 1000 cubic feet; and if all our customers were of this description, I should not be far wrong (taking into consideration the extra leakage) in adding ¾d. per 1000 feet to the cost. This would make, with the other items previously mentioned, about 11½d. to be added to the price of gas, which in my case is already rather high—3s. 9d. per 1000 cubic feet. I could not see that it would be a great inducement to small consumers to say we should want 1s. per 1000 feet more from them to cover expenses; and I came to the conclusion the better way would be to charge the same price to small consumers as to others—namely, 4½d. per 100 cubic feet. For meter hire we charged 7d. per quarter for 2 lights; and then we put on half the price of collecting—3d. per quarter. The consumers pay these sums—7d., *plus* 3d.—at the commencement of each quarter. The increase on our revenue owing to the weekly consumers is 5 or 6 per cent.; and I am fairly satisfied with that. My opinion of prepayment and cash meters is not very high. Mr. Millard then read the following observations on the subject of the results of the weekly collecting system at his works, as contained in a report he made to his Committee:—

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* See "Reports of Gas Associations" for 1890, p. 354.

> As the weekly collecting system has now been in operation for half a year, I beg to give you the results of same, which I consider most encouraging. The total number of names entered in the book up to Jan. 26, was 105. Of these there had been four discontinued; the

reason being in three cases owing to removal, and to expense in *one case.* Of the remaining 101, four he decided to go on the quarterly system. It is worth noting that of this number 24 were fixed to disused services, and four were fixed to services which, having been cut off at the main, simply required re-connecting. There are 29 displaced or replaced quarterly customers; but there is no doubt that, without the weekly system, fully one-half of this number would not have become gas consumers. There were 44 who required new services. As showing the growth of the system, on June 2 there were two customers, and the weekly collection was 10½d.; on July 7 there were 28, with a collection of 17s. 0½d.; Aug. 11, 38—18s. 4d.; Sept. 1, 41—18s. 3½d.; Oct. 6, 58—£2 17s. 11d.; Nov. 3, 82—£5 6s. 4½d.; Dec. 1, 94—£5 2s. 5d. The heaviest week's collection was on Dec. 22; being £5 19s. 1d. The total amount collected up to Jan. 26 was £97 19s. 0½d. I have no doubt that the increased revenue from this source for the next twelve months will be not less than £250. There have been added since the report was drawn up ten new customers.

Mr. V. Hughes (Tipton): One need have no surprise that Mr. Hunt hesitates to say much in favour of the prepayment meter, but prefers leaving it to someone else; and so shall I. We have had the weekly system in force for two or three years, and work it somewhat on the lines followed by the author of the paper and of the last speaker; and we have quite discarded the automatic meter. I agree much more with weekly collections; but I should altogether disapprove of the author's method of charging extra—*i.e.*, increasing the price—to these weekly consumers. We supply them at the same rate as ordinary small consumers. Our price to the smallest consumers is 2s. 9d. per 1000 cubic feet; and we allow a discount of 5 per cent. Now, in ordinary business, if you can get cash in advance, or cash on delivery, it is worth another 2½ per cent. So by collecting this money weekly, and not allowing these consumers any discount, you get an equivalent of 7½ per cent., which should cover any additional expense. Almost any youth can do the collecting; so that it does not require the payment of a large salary. We have a quantity of tickets, numbered consecutively (similar to railway tickets), each of a certain value. The collector takes out so many, and, of course, should return with so much money, by which means both the cashier and the consumers have a perfect check. These tickets we have found very useful. We have not a large number of weekly consumers, because we have not pushed the matter on account of our deficiency of storeage, in which we have been very badly off; but those we have all appear to be well satisfied. The author of the paper asks for an expression of opinion as to methods to be adopted in order to extend this system. I suggested to my

Committee, when we set about the business (it was never done, though they quite fell in with it), to allow a small premium on each new consumer the collector or canvasser could secure. I believe this would really be found to work very well. No doubt, weekly collections are a very great advantage. If you get a bad payer, put him on the weekly system, and you will have little trouble. We have several consumers who grumbled at paying a quarterly account of 10s. or 12s., who pay 2s. or 2s. 6d. a week as readily as possible. There is certainly a great future for the system; and those who try it will, I think, find it answer remarkably well.

Mr. **Millard**: I find I have some old notes which I had prepared for the last meeting; and I will supplement my previous remarks. We hire out two pendants or brackets at ½d. per week for the two; but my customers so far have preferred to purchase, except in a few instances. When hired, we have a small die or stamp to brand the ceiling-plate "Property of the Local Board."

Mr. P. **Simpson** (Rugby): What do you charge for extra work?

Mr. **Millard**: We charge 3d. per quarter for collecting. The cost of piping the houses is borne either by the landlord or the tenant—in no case by the Gas Committee; and we take payment for this, as well as for the fittings, by weekly instalments. The advantages of such a system as I have adopted over that of charging an inclusive price, to cover everything, are many. First, old customers can be readily transferred to the weekly system. Secondly, it will pay, even in the case of the smallest consumers. Thirdly, it is equitable, which is not the case with the other system. For example, suppose 6d. is added to cover all expenses, and one consumer uses 6000 feet, while another takes 12,000 feet of gas. The one pays 3s., and the other 6s., for exactly the same privilege; and you thus tax the best customers. Other advantages are that where the price is already rather high, it does not make the gas seem so dear; and there is freedom from all further responsibility and expense of renewals, and avoidance of all legal proceedings at changes of ownership or tenancy.

Mr. C. **Meiklejohn** (Oldbury): I have for some time been interested in the subject of weekly payments, and have consulted with Mr. Bell on the method he has in use. From my experience in past years, in works where the accounts were collected every six months, and then reduced to three months, I found a marked increase in the consumption, without the complaints generally following such increase. Monthly accounts would have the same effect in a larger degree. We are following local candidates and politicians in catering for the masses in this matter; and I suppose we are right. Whether or not it will pay, and the masses will accept the catering, I cannot say. My own experience, perhaps, is peculiar. I adopted the method of Mr. Bell, in offering to supply pipes, fittings, and meter, and make the connection free; and we only charge 3d. per 1000 feet additional on the price of gas. I endeavoured at first to do without an increase; but we were making a reduction in the price. Although we had 500 circulars printed, setting forth the terms on which we were going to supply gas, we have not had a single applicant for the weekly system. The only reason I can assign is that consumers in my district have souls above weekly payments. (Laughter.) Mr. Lewis and Mr. Bell have evidently solved the question of cost; but I should like to hear how they would overcome the difficulty of the gas consumers not accepting the system.

Mr. J. A. HARRIS (Wigston): I believe this is a step in the right direction, to popularize the use of gas among the masses of the people. I should prefer one factory to a hundred cottage consumers. But factories are not always at our command; whereas the artizan classes are, and we find these do not, as a rule, burn gas. The thing we have to face is how to get at them that they may become consumers. If we take them each quarter, the bills are too much at the end of this period. Considering the better times we live in, I think weekly or monthly payments are the right thing to meet the case; but we have to convince the working man that he is getting value for his money, and that it will be to his advantage to burn gas on the weekly or monthly system—that it will be safer and better all round. I believe we have not sufficiently advertised the utility of using gas for lighting purposes. If there is any new invention in oil-lamps, it is made known all over the country. By more advertising, and giving the public and the British working man definite results, it would help to convince him that it is to his advantage to use gas, and do so by these small payments. A man does not mind 2d., 3d., or 4d. a week; but he does mind paying 8s. or 10s. at the end of the quarter. Gas cannot be obtained, price for price and light for light, at the same rate as oil; but setting the small difference in the cost of gas against the continual breakages of glasses, the daily trimming and feeding of oil-lamps, and the danger in using them, I think, with a little business tact, we may largely increase our consumption amongst the middle and artizan classes.

Mr. HUGHES: So far as the fitting up of the houses is concerned, we supply all pipes and fittings, and fix the meter; and the prime cost to us is about 13s. to 14s. for a cottage with two lights, and about 20s. if we fix three lights. We charge 3d. per quarter for the hire of fittings where there are two lights, and 6d. for more than this number. We get the landlord to sign an agreement (which we have no difficulty in doing), giving us liberty to remove the fittings at any time we may wish to do so. We do this simply to prevent the landlord taking possession of the lot. I think the failure of Mr. Meiklejohn and others, is owing to the fact that the working-man can see that he is charged 1d. or 2d. per 1000 cubic feet more than the ordinary consumer; while the only difference in his case is the extra trouble in collecting, which, as I have before remarked, is covered by the discount and cash payments.

Mr. J. WEST (Manchester): I lately talked with Mr. Valon, of Ramsgate, on this subject, and he has a different system to the one we have heard advanced to-day. His plan is to have a meter which allows consumers to pay for any quantity of gas they please, according to their wants. A consumer can buy 1000 or 2000 cubic feet of gas or more; and the inspector takes the amount, and sets the meter to measure this quantity. If the people do not give notice for a further supply, it is automatically cut off. Mr. Valon tells me the system works admirably in his district.

Mr. HARRIS: I believe the cash meter is a step in the right direction. Few consumers can read the ordinary meter; and it is a satisfaction to a man to be able to read the index, and see at a glance how his consumption stands. When he cannot do this, it creates misgivings if the bill is larger than usual.

Mr. CHAS. HUNT (Birmingham): As prepayment meters have been mentioned in terms of praise, I feel it right to say that whatever merit attaches to their introduction in Birmingham does not belong to me. I am content to regard this question of extending the use of gas to small consumers as one of administration, of which the system of collection forms a branch. If the plan is adapted to the means of the class for whom you desire to cater, there can be little doubt but that you will attain your object. Therefore, I am not surprised to hear that the system of weekly collection has proved in many cases a great success. But I hold with Mr. Millard, who hardly seems to have had the courage of his convictions, that the supply to small consumers is not a remunerative source of revenue. He has stated that in his case the extra cost comes to about 1s. per 1000 cubic feet.

I shall be much interested to hear how he reconciles it to his conscience to charge the consumers a very much lower rate, if that is so. At the same time, the price to small consumers need not be regarded as a mere question of what will pay. When I first came to Birmingham in the time of the Companies, I was informed of the spirit of rivalry in vogue. Each Company did its best to secure consumers, however small; "for," said they, "the small consumer may grow to a large one some day, and then he will continue with us." The workman might develop into a master-man, become a large employer of labour, and consume gas on a very large scale. In this way, the use of gas may be largely extended among small consumers. Sufficient light has hardly been thrown on the cause of failure in Mr. Meiklejohn's case. If a desire to burn gas by paying for it weekly exists among the wage-earning classes, it is not easy to understand why this should be confined to one particular district. Why, for instance, should the system of weekly payments be successful at Tipton and not at Oldbury? Is the price of gas higher at Oldbury than at Tipton, or was it proposed to charge more in proportion at the former place.

Mr. **Meiklejohn**: It is 6d. higher at Oldbury.

Mr. **Hunt**: That seems scarcely enough to militate seriously against the system. Out of 500 persons to whom the circulars were sent, it is scarcely to be supposed that a difference of only 6d. per 1000 feet would be an obstacle to all. The question has been raised as to whether or not, light for light, gas can be supplied at the same price as oil. This must be answered in the negative. Gas can scarcely be expected to compete, light for light, with oil; but it possesses in other respects very important advantages. It is much less risky, and far more convenient. Gas must stand on its merits as a convenient light, rather than as being the most economical one. I was hoping to hear more of the experience of members with regard to the system which there is room to believe has been tried more extensively than this discussion would lead one to assume.

Mr. **Millard**: As to Mr. Hunt saying I have not the courage of my convictions, my small customers do really pay the extra amount I have mentioned, with the slight exception that I only charge half the cost of collecting, which is met by the freedom from bad debts and the interest on the money through its being paid when due, and also the additional revenue from the cheaper rate at which we can do new and increased business. As an example, last quarter I had a customer who burnt only 2000 cubic feet of gas, and paid, in addition to 7s. 6d. for gas

7d. for meter-rent, 3d. for collecting, and 6½d. for the hire of two pendants—making a total of 1s. 4½d., or 8¼d. per 1000 cubic feet; and in the summer quarter, if only 1000 cubic feet are consumed, it will mean 1s. 4½d. per 1000 feet. In addition, they paid for piping the house (10s.) by weekly instalments.

Mr. Lewis: I do not know there is much for me to reply to, as nearly all the speakers have answered each other; and, further, the statements and conclusions of my paper have not been criticized. There are, however, a few questions that have been raised during this discussion; and to these I will refer. Mr. Millard, who has started the plan of weekly collection, makes a great point of the cost of carrying out his system, and gives us various items, which he thinks should by rights be added to the price per 1000 cubic feet of gas, so that it is inclusive of all charges. I do not agree with his plan; for, on consideration, it will be seen that it is impossible to carry it out on any basis that will be satisfactory in practice. Take, for instance, meter-rents. If this item is charged in the price of gas, it is most unfair to consumers who use more than the average, and much in favour of those who use less than the average quantity of gas; in fact, it is making the larger consumers pay for the small ones. Meter-rent, if imposed at all, should be charged separately, as is generally the case. The cost of stationery is no greater with the weekly than it is with the quarterly customer; a quarterly card taking the place of the ordinary form of account. The cost of inspection and collection we find to be covered by the extra [illegible]d. per 1000 cubic feet charged. Beyond this, there is no other expense. I cannot see that there is anything in the argument of extra leakage caused by putting services in for weekly or monthly customers. We none of us object to put in a service, when requested, for quarterly customers, if our ordinary conditions are complied with. We have no guarantee as to consumption; and why should we object on this head with customers on the shorter system of payments? It is not pretended that it pays to supply each individual consumer singly; but taking their total consumption and all expenses into consideration, they certainly do pay to supply, and to go to some trouble to do so. There has been some mention to-day of experiments with prepayment meters. I hoped to hear something definite about these meters. But no one seems willing to give us his experience with them; and therefore I must conclude that the results are not so favourable as some would lead us to believe. At the last quarterly meeting, I showed a sample of Messrs. Cowan's meters, fitted with Mr. Cloudsley's cash-value indicator. I have not the meter here now; but on the table is an ordinary index with the cash-value indicator, for your inspection. We have a number of these in use among our monthly customers; and I think it is a step in the right direction, whether the appliance is used for weekly, monthly, or quarterly collections. It shows any consumer the cash value of the gas he is using. We know that many of our customers complain of their gas bill at the end of a quarter, and say they cannot have burnt so much gas as they have been charged for. This system of indicating the cash value of the gas used will do away with such complaints; and it must have been a great boon during last winter. With regard to the letting of fittings on hire, we offered some years ago to supply some in that way, but had very few applications; the great difficulty and hindrance being the piping of the houses ready for the fittings. If the landlord will do this, there is no difficulty about the fittings afterwards. As to the failure of Mr. Meiklejohn's attempt to start a short-payment system, it is difficult to give a reason for this, unless the absence of pipes and fittings in the houses to which circulars were sent, is one. Still, it is strange that no applications were received after the distribution of the number of circulars stated. Mr. Harris remarked that the working classes now live in much greater style than they used to do, and are not so thrifty as formerly. But I very much doubt if there is a greater want of thrift now than there was 50 or 60 years ago. I think, as a rule, people are more thrifty than they were. As to whether or not oil can compare, cost for cost and light for light, with gas, I showed most conclusively in the paper I read in 1888, that gas would not compare favourably with oil, light for light, unless its price is somewhere about 2s. per 1000 cubic feet. I think Mr. Hack corroborated that in some experiments he made. Therefore we cannot say that, for light alone, gas is as cheap as oil when it costs more than 2s. per 1000 feet; but there are other advantages which make it worth people's while to have it. It saves breakages and the trouble of attending to lamps, and so on. I mentioned on a previous occasion that we had in view the supply of a large village 4½ miles from Wellingborough. Before taking the gas there, the manufacturers named a price which they were willing to pay—viz., 4s. per 1000 cubic feet. We now supply the place; and all the manufacturers are using gas at that price. They have given up their oil-lamps—not because gas would be cheaper, but because the trouble as well as the nuisance of attending to the lamps were so great.

Instead of men being at work, they were found looking after the lamps; and it proved to be very much better to give them up altogether. This seems to me to be the only thing we can press on consumers to induce them to use gas where they now employ oil. When we started our system, I think Mr. Valon had just commenced his; and although his appears to be very successful, I think that there are some objections to it. The principal one is this: You go to consumers, and they pay for a certain quantity of gas; and the meter is set to supply that quantity. If they use more than they expect, their lights go out, and they have to send to the gas office before they can get the supply again.

Mr. West: That has been on only one occasion.

Mr. Lewis: I see that something of the same kind happened elsewhere. But I object altogether to the principle of causing people to pay in advance for the gas to be used. I find our system answers splendidly. We have not such a rush of fresh customers as we should like; but there is a steady influx, which is perhaps better than a great rush. This entails more office work; but the inspection and collection are simple. In the quarter ending at Christmas, the weekly consumers increased from 84 to 98; and the amount paid was £83 14s. 6d. for the gas used by them. That is a very good average. The monthly consumers increased from 66 to 116 in the same quarter; the amount they paid being £209 6s. 3d. I may say that we are so convinced of the importance of this system, that the Directors have decided that in future all consumers shall be on the monthly system—none longer than a month; and where we think it necessary, on the weekly system.

The President: I am sure we shall be united in offering our congratulations to Mr. Lewis on his success in bringing forward this question. I could not help feeling that the subject has two divisions—viz., frequent collection of rentals and letting fittings on hire. With regard to the more frequent collection, many now hold the opinion that it is an advantage in more ways than one. As to letting fittings on hire, my experience is not a happy one. Some 14 or 15 years ago, I thought of adopting the system in a Welsh town. Circulars were distributed; and the result in business was one application. We laid on the fittings—not for a cottager, for the man was a dealer in a large way of business. Although no one knew it, he was on the point of failing. We ultimately got our fittings back; but the cost incurred was more than they were worth. (Laughter.) With that experience, I have not since taken up the hire of fittings. With regard to

Mr. Meiklejohn's issue of circulars, it is politic to keep well in touch with consumers. This is done in some places by appointing an inspector to see customers, look at their burners and fittings, and advise generally, in a courteous and friendly way, where necessary. If an inspector had followed the circulars, there might have been some result. [Mr. MEIKLEJOHN: We tried that.] That ground is gone, then. With regard to 2-light meters, opinions differ; for in some towns there is a desire to dispense with the smaller-sized meters. About two years ago we thought it might result in business to distribute some boiling-burners among small householders, without making a charge of any kind. All we required was that the india-rubber tubing should be paid for. I have had the figures taken out, to get the result in consumption of gas. So far it is not encouraging; but we shall follow it up, with a view to getting more information. Our thanks are due to Mr. Lewis for his useful paper; and I propose that they be accorded to him.

Mr. SIMPSON: I beg to second the proposition, having been much interested in the matter discussed. Some companies have reduced the price of gas for cookers; and why should we increase the charge to cottage consumers? In my town (Rugby) we have many cottages and only one factory. With regard to what has been said about the working classes, I do not think with Mr. Lewis that they are so thrifty as they were in my grandfather's time; and I speak from experience. On some occasions, when the gas bill amounts to 12s. a quarter, it is difficult to pay the amount out of the week's wages; and when the husband has to make some little sacrifice of his own money, I know the gas does not get a good name. The wife has instructions to buy petroleum when she gets her weekly grocery; and the gas is given up. We talk about light for light, and about the cost of petroleum compared with gas; but there is to be taken into account the great expense for glasses and lamps for the former. If you take the cost of petroleum, you should add considerably to the price for these. If you have the weekly payment system, it is best to have an ordinary meter, and have the money weekly for what is burnt, without prepayment. It is a slur on a man to say: "You must pay the money in advance." We have honest poor men as well as honest rich men. What we ought to do is to prevent them getting into arrear; and that is only what is done in every trade.

The vote of thanks was then unanimously accorded.

Mr. LEWIS, in acknowledging the compliment, said he did not require any vote of thanks, as he felt it to be only right to lay before the members the experience gained with the short-payment system in use in Wellingborough, for it was only in this way they could get information one from the other. He was somewhat disappointed with the discussion, as he fully expected more adverse criticism, and he hoped to have a greater number of opinions on the subject.

This completed the business on the *agenda*.

The remainder of the time at the disposal of the members was taken up by an informal discussion of a question raised by Mr. R. O. Paterson, of Cheltenham, in accordance with an arrangement come to by the Committee that members should be invited to bring forward any subject for discussion at a meeting, where circumstances did not permit of a formal paper being prepared for presentation. The question mooted by Mr. Paterson was as to the effect on the illuminating power of gas of the admission of small quantities of air in the course of purification. A very instructive conversation ensued between a number of the members; but, as was intimated at the commencement, it was arranged that no report of proceedings of this character should be published.

The members subsequently dined together.

SOUTH-WEST OF ENGLAND ASSOCIATION.

HALF-YEARLY MEETING, MARCH 10.

This Meeting was held at the Offices of the Southampton Gaslight and Coke Company—Mr. S. W. Durkin, Engineer and Manager of the Company (the President), in the chair.

During the morning a visit was paid to the works of the Company, after which, luncheon was provided by the Directors at the offices.

The business of the meeting was then proceeded with.

The notice convening the meeting, and the minutes of the last meeting, were taken as read, on the motion of the President, seconded by Mr. W. Davis, of Poole.

New Member.

Mr. F. Durkin, Assistant Manager of the Southampton Gas Company, was unanimously elected a member of the Association, on the motion of the President, seconded by Mr. Davis.

The President then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—For the second time during the history of this Association, you have honoured me with the position of President. I accepted the responsibility with some diffidence, as I felt there were others who are more capable of fulfilling the requirements expected of one discharging the duties of such an important office. However, here I am; and as you on your part have to listen to what I may bring before you without comment, I will endeavour to interest you to the best of my ability.

Although the discharge of onerous duties at the various works under your care during the past rigorous winter have become history, I trust I may congratulate one and all on having come through the ordeal without mishaps worth recording; and most blessed was the man who had everything to hand for meeting the emergencies as they arose. As I am speaking to practical men, it would appear presumption on my part to think you have not made mental and other notes of the weak places in your plant, that have to be made strong for future demands; but I do so, as human nature forgets the cloudy day when the sun shines out with new strength, driving away winter darkness.

Be straight with your Directors or Committees as the case may be, and put before them the exact state of affairs, so that they may put you in a position to fight the electric light, oil, or anything else that "giveth light," but more especially to meet the yearly increase for the various purposes for which gas is now being used—viz., cooking, heating, motors, workshop appliances—yes, and even for killing people who like to blow out the light before they turn in for the night. But, of course, this ignorant use of gas does not obtain in this enlightened country. You have no right to be expected to watch till midnight to see if the gasholder will keep afloat, for want of storeage or of producing power, or that your purifying plant is squeezed into the smallest limits for doing its duty, or that your distributing plant is so wanting in calibre as almost to necessitate the use of an exhauster to keep up the pressure in the district; for be sure economy of the cheeseparing type will bring its reward in trouble. Then, on the other hand, when you have convinced your employers as to the necessity for extensions, see that the means granted are well and profitably laid out.

Like other towns, we have had an extraordinary demand on our resources; and it has been met, and the supply of gas well maintained. But it was a lively time, fighting the low temperature on the works and in the district. My Directors, however, know what they have to do to keep pace with the growing demand for gas; and extensions have been sanctioned with this object in view. I said in a former address that the profits were made in the retort-house. Well, I do not see any reason to alter that opinion; but this can only be done when Directors find the sinews of war. This I omitted to state; for if the capital did not build the retort-house, &c., where would profits come from?

In the face of the increased cost of coal, every economy of a right sort is needed; for it does not appear that prices will go back to the low figure—and, in my opinion, a too low figure—that obtained a few years since. It is satisfactory to know that the miners get some of the extra price paid; and I believe the general opinion to be that they should be fairly recouped for their hazardous duties. It is true that the enhanced price of raw material enables one to obtain a better price for coke. Just now tar is firmer; but, whether or not this continues, outside influences beyond the control of gas companies may rule the price of this product. Those of you who manufacture sulphate cannot look for much extra help in this direction. But as my Directors have determined not to give away their liquor, plant is being laid down for working it up; and although sulphate is down, we hope to get something out of it.

Against advantages obtained in one way, there is often a pull on the purse-strings in another—in the additional demand for wages, &c. You no doubt recollect that this town was the centre of attraction last autumn, during the dockers' strike, the fringe of which just reached the gas-works, as far as some outside men were concerned. But their requests had consideration; and the concession made by my Directors, after an interview with the men in my presence, was received in a very pleasing spirit. You are aware that we work under the eight-hour system in the retort-house; and from time to time concessions have been made to the stokers and the yardmen, so that, on the whole, matters have gone on harmoniously. As the men are under the control of the manager, he should be the "buffer," so to speak, or intermediary between employer and employed; and it has been so here. I do not agree with the view that any institute of gasmen should be used for framing a general law on wages, as some propound. Every district has its own peculiarities, and must be dealt with distinctively. I do think, however, that strikes are a barbarous method of settling differences, and they often hit those who expect to get something by them. If boards of conciliation or arbitration could be formed when required, with this end in view, we might extend some help; but it would never do to set ourselves up in antagonism to men with whom we come into daily contact. Here I leave the question, which wiser heads than mine have not solved. But let both sides strive to act up to the command: "Do unto others as ye would be done unto."

I am afraid you will consider I have been traversing things in general, and giving you nothing personal. We have not gone in for the many tempting methods offered for improved carbonizing plant. I have seen some of them in operation, and the technical publications keep us posted as to these matters. The survival of the fittest will be the one needed for our work.

I still adhere to the air process in purification; but I consider the pure oxygen process to be something better, and I understand reliable data can be given to show its commercial and other advantages. For the encouragement of those who have refrained from going into the sale of broken coke, I would say, "Try it," for I find we are doing a large and increasing business in this residual, and the more you can sell locally, the better for the companies you represent.

As to extending the use of gas in this town—well, without a great flourish of trumpets, something has been done. Prior to 1886 we had about 20 cooking-ranges out on hire. In that year we held an exhibition of gas appliances, with cookery demonstrations, which was much appreciated by the inhabitants, and brought up the number to 155. A gradual increase has taken place year by year. After an interval of time, we had cookery demonstrations in this room, which were well attended; and last year another successful exhibition, which was very satisfactory. At the present time we have upwards of 400 ranges out on hire. They are so much appreciated that users recommend their friends to adopt them. But the poor untrained domestic is our worst enemy; and no doubt from what I hear, many consumers would start a range, only that they are afraid of the gas bill. We have had for several years a sample-room in this building; and so good service has it rendered that my Directors have now determined to fit up the front basement (which I was desirous of having ready for your inspection, but you must take the will for the deed), and keep various appliances on view. If we can start a cookery class for servants, giving practical instruction in the use of gas for various purposes, a triple gain may accrue—first to the consumer, secondly to the servants, and thirdly to the Gas Company. Heating-stoves are sold right out at reduced prices, and a large number have been disposed of; these and cookers being charged cost price for fixing. I do not at present see my way clear to recommend my Directors to let heating-stoves out on hire, for which I have my reasons. You may buy your increase of business at a loss. A very sensible increase in day consumption has arisen, but bear in mind that in the winter increased day consumption means good storeage and extra producing power. My advice to those of you who have not commenced the hiring of cookers is not to "rush" the system on your consumers. No general rule will apply. You know your districts better than do the makers of apparatus, whose aim is to obtain large orders. You, however, have to bear the brunt of the battle if non-success attends your efforts; and it will be better to succeed gradually.

With regard to the gas-fitting business, we have only gone into this when specially called upon. I have recently fitted up the Volunteer Artillery Drill Hall and the Victoria Hall, with satisfactory results; and I frequently advise architects as to lighting arrangements.

Street lighting has received a good deal of attention; and by fixing improved lanterns, with powerful burners, for inspection, the Borough Surveyor has induced a more enlightened policy to be pursued by the lighting authorities, they having adopted them at the principal crossings. Within the two last years, a modification of Sugg's "Métropole" lamp has been fixed in some of the principal thoroughfares, with three burners used up to 11 p.m. when the midnight arrangement is turned on until morning. The general opinion is that a vast benefit has been conferred upon these parts of the town; and the proverbial shadow under which evildoers could shelter themselves, has so far disappeared. We hope to extend this system, as "our friend the enemy" is in our midst; and we trust he may be still the "light of the future"—for the sake, of course, of the poor ratepayer.

There is another matter which I notice is coming to the front—namely, the item, "Rent of meter." In some towns it "is not;" and in others it is on the wane. It may appear tender ground that I am treading upon; but, looked at from a practical point of view, one hindrance to extending the use of gas would disappear with the abolition of meter-rents. Consumers have a vague idea that having meters a little large for their requirements means a heavy gas bill; but it is often the charge for meter-rent they have in their minds. If a consumer overloads his meter—a thing which is continually being done—what remedy have you? I cannot find any Act relating to meters that will assist you very materially. I would suggest, if meter-rents are not abolished, that the amount should be reduced to some extent and that three and five, ten and twenty lights, and so on, should be grouped together at the same rental. This would cut away the objection to the use of a proper sized meter; and the vague idea above referred to would possibly disappear. I should like to throw out a hint to some member to take up the question in a paper for our autumn meeting; it being a subject which, with a good discussion, should produce beneficial results.

We are very much indebted to gentlemen outside gas-works for valuable contributions on gas manufacture and the chemistry of gas lighting. I may cite the Cantor Lectures on "Gaseous Illuminants," given before the Society of Arts towards the end of last year by Professor Vivian B. Lewes,* as an example; and I will add that they will well repay your study.

In conclusion, I have to thank you for your kind attention to one who is fully aware of his own shortcomings in building up an address; and I can only trust they will be hidden under the practical papers to be read to-day, on which I hope there will be good discussions.

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* See *Journal of Gas Lighting*, Vol. LVI., pp. 1140, 1194, 1240, 1288, 1334.

A vote of thanks was unanimously accorded to the President for his address.

Mr. E. C. Riley (Swindon) then read a paper entitled—

SOME NOTES OF EXPERIMENTS ON THE POSITION AND WORKING OF THE HYDRAULIC MAIN.

I have consented to offer these notes at the request of our Secretary, under the following circumstances: In September last, I was unavoidably prevented from being present at the half-yearly meeting; and being somewhat interested in the subject on which Mr. Humphrys had undertaken to read a paper,* I gave, in my letter to him, some memoranda of alterations made in the position of the hydraulic main in our retort-house at Swindon, with the results. He was kind enough to consider the notes worth giving separately as a short paper at this meeting, together with any additional experience we might obtain from the winter's working. This is my explanation for bringing before you merely a simple statement like the present; but, in compliance with a wish expressed by some members that actual practical results, obtained from alterations to, or experiments with, plant should be brought before the members for consideration, I have ventured to submit these notes to you.

I should state, first, that the North Wales coal which formed the bulk of our coal supply in the retort-house to which I am referring, while yielding, on an average, about 10,000 cubic feet of good gas per ton, gave a very thick pitchy tar, which accumulated in the main, and gradually filled the bottom part with a solid deposit that eventually reached the dip-pipe. Towards the end of the time when the bed should be dropped, it would be only with the greatest difficulty on the part of the men that the dips could be kept sufficiently clear to get the gas away; and the frequent stoppages, and constant necessity for work on the top of the beds, were a source of great discomfort and annoyance to the stokers, as well as general loss of time and gas. The expense also, whenever a bed was dropped, of taking off the covers of the main, and chipping out the tough, pitchy mass with chisel-bars and sledge-hammers, was considerable.

The retort-house contains seven through beds of seven retorts each, or 98 mouthpieces in all; and I decided to try the effect of raising one section of main for one bed of 14 mouthpieces. Accordingly, arrangements were made to lift No. 7 to the extent of 1 ft. 8 in., or a total height of 3 ft. 2 in. from the top of the bed to the bottom of the hydraulic main, and work for a like period, with the same coal, and under entirely similar conditions to the adjoining bed, No. 6. As this was merely an experiment, the same ascension-pipes were used again; the additional length being made up by the insertion of a short flanged making-up piece between the top of the ascension-pipe and the arch-pipe, and a bend put in from the back of the valve to the collecting-main running along the top of the bed.

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* See "Reports of Gas Associations" for 1890, p. 256.

We worked No. 7 bed with the raised main from Sept. 6, 1889, to March 17, 1890—altogether 192 days; and No. 6, the adjoining bed, which had not been altered, from Sept. 9, 1889, to March 22, 1890, or 194 days. In the former, the tar remained all liquid during the whole winter—giving no trouble whatever; and when the bed was dropped, the contents of the main all ran out in a perfectly fluid condition. In the latter, the usual solid, pitchy mass was formed in the main, up to the level of the gas outlet; and the usual expense and trouble were incurred in cleaning out. In order to prove the matter still further, and make sure that the result was not merely some erratic effect of position in the house, or temperature and ventilation, or other mysterious cause operating in the particular situation of that special bed, I had No. 1 (which had always been the most troublesome on account of stoppages) altered in the same way, and worked it against No. 2, which was not altered; and here again the same results were obtained as with No. 7.

I considered this double test as sufficiently reliable to justify the alteration of the remaining mains in the house; and this was done in the autumn of last year (1890). This winter, although you are fully aware of the special demands that have been made on all gas manufacturers, we have practically had no trouble with our hydraulic mains or ascension-pipes; and I am perfectly satisfied that the simple alteration to which I have referred has already more than repaid the expenses incurred in carrying it out, while it has immensely increased the comfort and facility of working for the stokers. I am not prepared to suggest that similar results will follow in every retort-house, as I am satisfied that each manager must study his own particular case, and the construction of his house, the description and arrangement of his hydraulic and foul main, and, more especially still, the character of the coal he has to work with, all of which factors will have to be considered in deciding what steps should be taken to overcome the difficulty of thick tar deposits in his own works.

It will be remembered that one of the objects of the arrangement of foul and hydraulic main described by Mr. Humphrys in his paper read in September last year, was the maintenance of the contents of the hydraulic in a perfectly fluid state; but that the arrangement was only adapted to a main which was open throughout, and was practically inadmissible in the circumstances of the experiment I was trying, where the main was divided into separate sections for each bed. The different methods adopted respectively in aiming at a similar result merely illustrate the old proverb: "Many men, many minds," and show that there are often several paths leading to the same goal.

The gas from the separate sections of the hydraulic main passes through a bridge-valve at the back into 8-inch collecting-mains, which run the whole length of the house, parallel with the hydraulic on top of the bed, and in which the gas travels in a slightly ascending plane to the 12-inch foul main, which runs round the house, while the tar flows in the opposite direction to a separate pipe leading to the tar-well. It will thus be seen that in the collecting-mains the principle of the gas travelling in the opposite direction to the tar is adopted; while in the foul main itself the gas and tar flow together.

I am not prepared to offer any remarks as to the theory of the proper dimensions for the foul main; but I may mention, in contrast to the illustration given by Mr. Humphrys of a make of 144,000 cubic feet of gas per day, where the suggested diameter suitable for the foul main was 19 inches, that in our Swindon house the maximum make is 500,000 cubic feet per day, while the diameter of the foul main is only 12 inches, and the length about 100 feet. Consequently, on the basis assumed—*i.e.*, that the capacity of the foul main should be equal to two minutes' make of gas—our main is only about one-ninth the dimensions it should be, as the make per two minutes would be 694 cubic feet, and the capacity of the main only 78 cubic feet, while the rate of travel would be between 5 and 6 feet instead of 1 foot per second. Of course, I am aware that at the commencement of the works a nearer approach to the suggested theoretical position is attained; but the fact that ten years since, on the opening of the works, the make of gas per annum was 50 millions, and that now it is 110 millions, altered the ratio of the foul main to the make. But I think that the larger the works, the further will that ratio be from reaching the ideal theoretical standard to which I have been referring.

I have not taken the collecting-mains into consideration, as only a portion of the gas made travels through the full length of the mains; but they would to some extent be a factor in the question of condensation, as well as the capacity of the hydraulic main itself—its outside surface area above the liquid level. I am, however, perfectly satisfied that a strong case has been made out by Mr. Humphrys as to the importance and value of the slow condensation afforded by a large and long foul main; and those of us who have alterations and extensions in hand, would do well to give this matter every attention, and, for our mutual benefit, note the results obtained with altered plant, as compared with working under previous conditions. By this means, we shall make our meetings increasingly attractive and valuable to each other from a really practical point of view; and it has been largely with this hope that I have given the results of our experiments with the hydraulic main at Swindon. But, in proof of the effect of different kinds of coal, I may mention that at our works at Wormwood Scrubbs, near London, where a higher standard of illuminating power has to be maintained, and a different class of coal is used, no trouble is experienced with thick tar, although the hydraulic is right down on the top of the bed. When, however, owing to a delay in the supply, North Wales coal had to be employed, the same difficulty culty arose, and continued until the other coal was received.

Discussion.

Mr. J. H. Lyon (Cosham) said he thought the kind of coal used had as much to do with the thick pitch in the hydraulic main as the position of this appliance. Mr. Riley got rid of the trouble by raising the main, which showed that it was caused by excessive heat received from the top of the stack. Apart from this, his impression was that the nearer the hydraulic was brought to the mouthpiece—*i.e.*, the shorter the ascension-pipe—the greater was the risk of a deposit of pitch. At Manchester considerable trouble was experienced from pitch and smoky mouthpieces; and Mr. Alderman King had introduced the arrangement illustrated in the drawing before them [see next page], consisting of a sort of collecting-box inserted in the upper part of each ascension-pipe. Experiments of long duration had proved conclusively, that a certain condensation took place above the point A; and the greater the distance between this point and B, the greater was the condensation, and consequently the larger the quantity of tar and liquor that would be collected. The Manchester Corporation Gas Committee had 250 of these appliances in use at their Gaythorn station; and they were going to increase the number to 700. At this station the tar and liquor collected and measured was, on an average, 1¾ gallons of tar having a specific gravity of 1·24, and 4¼ gallons of liquor of 2° Twaddel, per ton of coal carbonized. The appliance was placed in the position shown. The condensed matter was collected at C, and carried away by the overflow-pipe to the receiving-trough. Taking it that each retort carbonized 10 cwt. of coal per 24 hours, the annual saving in tar alone by using Alderman King's apparatus was equal to 22s. per ascension-pipe or mouthpiece, taking the tar at 1d. per gallon, or 16s. 8d. per ton. The result of using the appliance had been to get rid entirely of choked pipes and smoky mouthpieces; and if Mr. Riley adopted the plan, he would not only be relieved of such troubles, but add considerably to his yield of tar and liquor by collecting matters that formerly went back into the retort and were wasted.

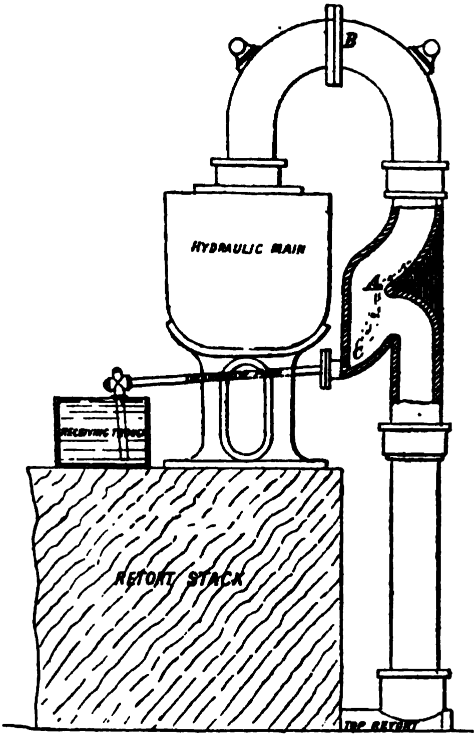

FIG. 1.—KING'S CHOKED PIPE AND SMOKE PREVENTER.

Mr. A. THOMAS (Cowes) noted the idea conveyed by Mr. Lyon. He understood Mr. Riley to say that in the first place there was 18 inches of clear space between the top of the stack and the hydraulic main; and that by practically doubling this distance he had got rid of the thick tar. He (Mr. Thomas) did not think that very much heat would be conveyed to the hydraulic main through a clear space of 18 inches; and he was therefore inclined to look in another direction for the cause of the improvement. Raising the hydraulic also involved the lengthening of the ascension-pipes to a corresponding degree; and perhaps the additional 20 inches of pipe was really the means of preventing the thick tar from reaching the hydraulic. Evidently the evil was cured; but perhaps the longer ascension-pipe had more to do with it than the additional space between the hydraulic and the retort-stack.

Mr. J. BRIERLY (Borough Analyst of Southampton), in response to an invitation from the President, said that, although he was not a gas manager, he was, as a chemist, greatly interested in the matter before the meeting. Evidently there was a difference in the properties of the coals used at various gas-works. At Manchester, the chief cause of complaint was smoky mouthpieces. But Mr. Riley did not mention these; his particular difficulty was thick tar or pitch in the hydraulic main. There was nothing before the meeting as to the different circumstances of temperature and conditions of carbonization that might or might not prevail at Manchester, Swindon, and Wormwood Scrubbs respectively; but they would scarcely be so far dissimilar as to account for the variation in the results observed. The difference in the properties of the coals was evidently the chief cause. When the ascension-pipes were lengthened, the effect was to increase the proportion of volatile matter that was condensed in the pipe and returned back to the retort. One effect of the alteration was that certain matters which formerly were carried into the hydraulic main were returned to the retort; and perhaps they were cracked up, and either wholly or partially converted into permanent gas. In that case, the alteration ought to have caused some improvement in the yield of gas per ton of coal; and he should be glad to know if this had resulted. If so, it would follow that some of the matters which formerly went to form pitch were now converted into gas.

Mr. W. DAVIS (Poole) asked for particulars as to the means adopted for drawing the tar from the bottom of the hydraulic. He found that when the hydraulic was so near the arches that it became considerably heated, there was a tendency to produce pitch. But by drawing away the tar from the bottom, he overcame this difficulty. Using a bridge-valve, and taking the tar from the bottom of the main, would remedy the accumulation of pitch.

Mr. F. G. DEXTER (Winchester) wished for information as to the effect of the alteration with regard to choked ascension-pipes. He asked if Mr. Riley had been troubled with them either before or after raising the hydraulic. Also if the tar simply passed away over an overflow, or was drawn from the bottom of the hydraulic.

The PRESIDENT said he had been brought up in two different schools of carbonization. In beginning, he had to do with iron retorts; and then, under Mr. Paddon, who had been Consulting Engineer to the Southampton Gas Company for 25 years, he was inducted into the clay-retort system. With the iron retorts, they sometimes had choked ascension-pipes; but never any accumulation of thick pitch in the hydraulic main. The tar and liquor flowed away with the gas; the gas went to the holders, and the liquids to the wells. But a day of change came, with good results to the shareholders; and the clay-retort system proved that there was really more gas in a ton of coal than had been supposed. Other difficulties, however, came in, especially the thickening of the tar. Where did the extra gas come from? He used to suffer much from thickening of his tar; and a few years ago he read a paper before the Association on the subject of taking this product from the bottom of the hydraulic main. He gave therein the results of putting into practice ideas he had seen applied at other places with good effects. Since adopting this plan, he had not been troubled with thick tar in the hydraulic. It was very probable that the class of coal used was concerned in the matter. At Southampton, he generally used Durham coal, which was known to be more troublesome than certain kinds in this respect, though giving good results in others. He took the tar out of the main as soon as possible, and allowed the dip-pipes to seal in liquor only, and not in tar. The hydraulics were periodically flushed out with liquor; thus keeping the contents stirred up, and not allowing anything to settle. The tar pumped from the store-wells was rather thicker, and gave more trouble to the distillers, than that formerly yielded by iron retorts with a make of 8500 cubic feet per ton.

Mr. RILEY thanked the meeting for the kind reception accorded to his paper. He said his experiences had run more in the direction of trouble from pitch in the hydraulic main than from choked ascension-pipes, though he had these to deal with sometimes. He could not credit the alteration with any marked improvement in the yield. Coals varied in quality from time to time; so that it was difficult to make a close comparison. But he was under the impression that there was some slight increase in the production of gas. With reference to the observations made by Mr. Brierly, he agreed that the increased length of ascension-pipe might afford some benefit, as well as the reduction in temperature secured by raising the hydraulic main. The gas would reach the hydraulic at a lower temperature than before. So that both causes probably helped towards the result. With regard to taking off the tar, his hydraulics were in separate sections for every bed, with a bridge overflow at the back of each. Beyond this, no special means were used to take the tar from the bottom of the mains. He could not say that the alteration had led to any marked difference in the matter of choked ascension-pipes; but he thought that obstructions were rather less frequent now than they were under the previous working. The dip-pipes had certainly required much less attention than before. He might say that at Wormwood Scrubbs they had to make gas of good quality; and they used a very high-class north country coal, that would yield 11,000 cubic feet of 16-candle gas per ton.

The other paper read was by Mr. F. G. Dexter, of Winchester, entitled—

SOME EXPERIMENTS ON THE REVIVIFICATION OF OXIDE OF IRON IN CLOSED BOXES.

Some time ago the idea occurred to me to try to reduce, or obviate entirely, the cost of emptying and refilling purifiers. The opinions expressed in existing accounts of attempts to revivify *in situ*, by the admixture of air with the crude gas, being somewhat divided as to whether any reduction in the illuminating power of the gas does or does not result from this practice, I wished to try revivification on boxes "standing off" as foul, and therefore altogether out of contact with passing gas—a process which, if successful, would effect great economy, avoid a standing nuisance, and meet the scruples of those who, though acknowledging the desirability of reform in this department, objected to effect it at the risk of lowering the illuminating power of the gas.

In commencing the experiments, I had the fixed idea that we dealt with a solid body capable of undergoing particular changes by the application of coal gas under certain physical conditions of rate of flow and pressure, and that this material, when fouled, could be made to undergo the reverse changes by the application of another gas, oxygen; and therefore, if this second gas were applied to the spent material under similar conditions inside the box, then the reverse action—revivification—should be effected without difficulty. I had constructed a small test-box, made to the scale of one of the purifiers on the works. The inlet in the centre of the bottom was connected direct to the inlet-main of the purifiers, and also by a branch service, controlled by taps, to a small holder containing air. On the top of the box, in place of the usual vent-plug, a leak-detector was fixed; and in one corner a pressure-gauge. First filling the box with fouled oxide taken from a purifier just shut off, I carefully passed the air through until it appeared revivified, and then shut it off entirely, to wait until the same oxide, taken from the works' purifier, had been renewed in the ordinary way, and put back. The foul gas was then sent into this box, and at the same time a small quantity, in proportion to the hourly make and the size of the test-box, was turned through that. By this arrangement I had two purifiers, each purifying coal gas of the same consistency in proportion to their respective capacities, and both filled with the same oxide, but with the difference that while the oxide in the works' purifier had been revivified as usual, that in the test-box had been revivified by a current of air passed through it. It will be understood that the registration was obtained by the station meter on the one hand and the leak indicator on the other. The gas was carefully tested every hour.

The result of this experiment was that the works' purifier ran 14 days without showing any trace of sulphuretted hydrogen, while the test-box lasted three days longer. When fouled, I revivified the test-box by the air-holder as before, and then again worked the foul gas through; repeating this alternately with perfect success so often that it seemed waste of time to further prolong the experimental trial with the test-box. Accordingly, to the inlet-main of the works' purifier I attached a 2-inch air-pipe, which was carried through to the engine-house, and attached there to a small pressure-blower, the pulley of which was driven direct by a belt from the fly-wheel of the exhauster engine. My intention was to reproduce the exact conditions of the test-box on a larger scale, when it seemed to me that success was certain to follow.

The drawing I have prepared is a section of the purifier, and represents in transition the conditions of three distinct series of trials. Section No. 1 shows the first attempt. In this case I had a free current of air passing up through the box, and escaping by the top centre plug, as shown. The pressure in the box was 3-10ths of an inch; and it took three days to revivify 8 inches of the top layer of material [shown by the vertical shading in the section]. Then with a sharp line of demarcation, the foul oxide [shown by horizontal shading] commenced, to all appearance as bad as if no air had ever passed. Complete revivification was effected in about eight days. This result clearly proved that the conditions of revivification differed from those of the test-box, and the difference was this: During the test-box trials, the air was filtered through at slow velocity, and under the same pressure as obtained in the box during the passage of the coal gas; but in the trial of the works purifier above alluded to, a large volume of air passed while the pressure was only 3-10ths of an inch. To obtain the increased pressure required, I introduced counter-shafting between the exhauster engine and blower; and after fouling the box again, the air was turned on at a pressure of 7-10ths of an inch, and the flow diminished by the plug at the top being set partially open with small wedges. The greatly improved result of this change is indicated by section No. 2; the air having penetrated in the same space of time right through the top layer, and a small portion of the second. In addition to this, revivification had set in to some extent at the bottom. Complete renewal was effected in five days.

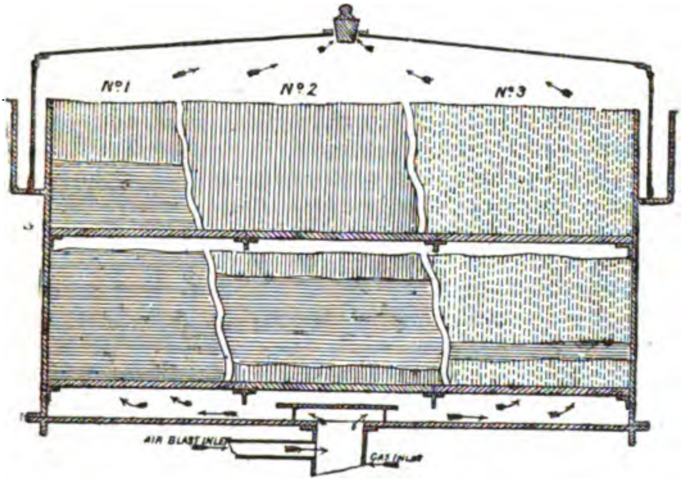

FIG. 2.—SECTION OF PURIFIER, SHOWING RESULTS OF DEXTER'S REVIVIFICATION EXPERIMENTS.

After several other trials to settle satisfactorily in my mind some points that occurred to me as worthy of closer investigation, I began the next and last series of trials, shown by section No. 3. Into the same box, fouled as before, the air-blast was turned at a pressure of 1½ to 2 inches, and with the flow still further reduced. In two days the box was revivified through the top layer [see dotted lines], and very nearly through the second; the narrow streak of 3 inches that remained being disposed of well within the third day. In this case also revivification had set in to a slight extent from the bottom upwards, independently of the principal action downwards. I did not experience any difficulty in repeating these results on the same box several times over; but as they pointed all through the experiments to the necessity of reproducing, as nearly as possible, the same conditions in the box during revivification as obtained during the fouling of the oxide by the coal gas—that is to say, a slow movement of air, producing lengthened contact with the oxide, at some degree of pressure—I greatly desired to work up in one, or at the utmost two more stages, to the final conditions of air current and pressure used in the preliminary test-box experiments, when to revivify a box completely should take some 24 to 30 hours only, and thus reduce the process to limits thoroughly practicable and convenient.

Unfortunately, having but the smallest size pressure-blower fixed for these trials, I found that its capacity had already been reached, and the maximum pressure wanted—6 inches—could not be obtained without so far reducing the current as to impair the results. Being at this time about to remove to take my present appointment, I had no means of getting a larger pressure-blower fixed to bring the trials to a final issue, but only to establish the fact that any reduction, either in the pressure or quantity of air used during the trial represented by section No. 3, led to a prolongation of the time required for revivification.

In case it may not be very clear to some why importance is attached to the question of pressure when we are considering purely chemical reactions, I would explain that it is simply to the physical, and not the chemical aspect that it has reference. For instance, comparing sections Nos. 1 and 3, there was no appreciable difference in the efficiency of the revivified oxide—the chemical part of the work being equally well done; but compared on the time basis, No. 3 section is an advance of about 400 per cent. on the results of No. 1 section. The condition of pressure simply enables the air to penetrate the pores of the oxide in sufficient quantity within a practicable space of time.

Circumstances preventing my following up the results just now, I have determined to place them before you as they stand, in the hope that they may interest, or still better incite some to take up the thread, and bring the work to a satisfactory conclusion. Many of the features of these experiments appearing strange to me, I read up as much information as I could find relative to the behaviour of oxide as used for purification; and in doing so I discovered that, some time previously, attempts to revivify oxide upon somewhat similar lines had been made, and had proved quite successful up to the third or fourth renewal, when the back pressure brought about by the caking of the oxide became prohibitive. It appears, however, that the air-blast was obtained by means of a steam-jet injector. This fact—the presence of the steam—is, to my mind, largely responsible for the back pressure recorded; as the soddening effect it has on the oxide has doubtless been noticed by those who have had occasion at any time to steam the plant anywhere near the inlet to the purifiers. Of course, the oxide does harden to some extent, as in every other process of revivification *in situ* ; but mere back pressure, within reasonable limits, in the boxes or anywhere else, is nothing to be afraid of, so long as it is kept off the retorts. It is, after all, a question of degree; the working pressure during the summer in certain works being a great deal heavier than at others under maximum strain in winter. I am quite sure also, from the results obtained during the experiments, that the oxide in use in different works might be readily treated with some opening material, to counteract any excessive caking tendency.

With regard to the possible objection entertained by some, that great risk is run of the box overheating and firing, I would say that it is a point which need not be feared in the slightest degree with ordinary care. The heating being due to the chemical reaction of the sulphide of iron and oxygen of the air supply, the temperature reached in the box depends entirely upon the quantities of these substances brought into contact within a given time; and it is a simple matter to keep the air supply checked within the necessary limits until the more violent action is over. In practice, I found that the box reached within the first two hours the maximum temperature which appeared to be safe, and that after this it rapidly cooled; so that in about 2½ hours from the start, no further attention was necessary—the air-blast being turned on fully and left to do its work.

The action which has puzzled me most is the behaviour of the oxide under the air-blast, as indicated in the drawing. I fully expected to find that, as the oxide is fouled from below unwards, in the direction of the flow of the gas, the introduction of the air in precisely the same manner would lead to revivification in an upward direction, with the flow of air. But the very reverse took place—the air passing right through the whole bulk of material, and then revivifying from the top downwards. It was only after prolonged contact that any revivification was noticeable at the bottom, where the fresh air came into contact with the oxide first, and then only to a slight extent. In the middle space also, where air would be assumed to collect, not the slightest indication of revivification manifested itself until the top layer was wholly revivified; and then the action continued downward through the second layer, in like manner to the first.

Another important point which should be clearly understood is that I could never discover any transition stage, as it were, or band of partially revivified oxide, between that already renewed and the foul material. Sections of the oxide taken at all stages revealed the conditions I have depicted in the drawing; the revivified oxide being in close contact with perfectly foul material. I wish it to be distinctly understood that each section represents the conditions over the whole box; the sharp line of demarcation extending horizontally with perfect uniformity right across. Repeated examination of the corners, middle, sides, and ends gave me the same result; no single instance occurring of greater penetration of the air in one part than another. This examination also disposed of the idea that once occurred to me—that the air had by some means taken a short cut through fissures in the oxide, or loose sides, and so found its way through to the top first. So that the only explanation of the phenomena that presents itself. appears to rest on the assumption that some series of chemical reactions occur during the passage of the current upwards, unless it may be met by the simple fact that the air really does act equally throughout the oxide. But inasmuch as the oxide is the most fouled at the bottom, and is proportionately less so towards the top, the effect of revivification is seen to progress in apparently the reverse direction, from the top downwards through the material, requiring longer contact in proportion to the work it has done. In any future experiments that may be attempted, it might prove desirable to introduce air between the layers of oxide as well as below.

I trust it will be clearly understood, by those gentlemen who freely advocate the air process as ordinarily understood, that these remarks are not made in any sense of rivalry to that.

Personally, I consider the ordinary air process of greater value than that put before you now; and the pure oxygen the best of the methods of dealing with our solid purifying materials. But for a time there are not likely to be many in a position to deal with oxygen; and although the ordinary air process will deservedly become more largely adopted than it is now, there will remain many hard-worked managers who, without skilled assistance, and unable to devote the necessary attention themselves, would fear to risk the introduction of either air or oxygen with the gas. To these especially, some such process as the one now before you, requiring, at the most, two or three hours' attention each time a box has to be renewed, ought to be of value.

Glancing for a moment at the question in its general aspects, we see that, being able to purify coal gas by contact with the solid material, oxide of iron, we effect this contact by bringing the gas to the solid body as a more expeditious and economical method than any attempt at a reverse order of things could possibly be. So far, so good. But this same solid material is capable of being again rendered fit for purification, not by the laborious application of other solids or liquids (when some excuse for the wasteful and costly system of its removal from the boxes would have existed), but by the simple application of another gas—oxygen—either in the pure state, or mixed with nitrogen as air. Why, then, having once practised economy, do we throw our ideas of economy to the winds—*i.e.*, the oxide to the air? I think this question cannot be answered without admitting the room for improvement, especially in these days of keen competition and high-priced, though uncertain, labour; and I feel sure that, in the near future, the use of solid materials for purification will only be tolerated in conjunction with some revivifying system which admits of its prolonged use without removal. This done generally, will leave the gas manager one advantage the less to make use of to widen the gap between the industry he guides and its many competitors; but it will also be one step nearer that degree of perfection which it should be the aim of every man to reach.

Discussion.

The **President** remarked that they had listened to a paper bearing upon a subject that had occupied a prominent position lately, and on which almost all members could say something.

Mr. N. H. **Humphrys** asked if Mr. Dexter had any idea of the volume of air passed through the purifier in the course of revivification.

Mr. A. **Thomas** (Cowes) considered the paper an excellent one.

He might remark that 30 years ago, Mr. J. Esson, of Cheltenham, tried some experiments on similar lines. The purifiers were on the overhead system; and a 9-inch pipe was laid to the inlet, and air was driven through it by an exhauster. He (Mr. Thomas) was foreman there at the time, and helped to put up the pipes; but he happened to leave for another appointment before the system was actually tried, and therefore he had never heard the results. The difference in pressure evidently had a great deal to do with the time required for revivification; and the greater the pressure, the more rapid the result. He would like to know if this held good up to the highest degree of pressure the purifier would stand, or, if not, the highest limit to which Mr. Dexter would be inclined to go. He should be glad if the result asked for by Mr. Humphrys could be arrived at; but the question should be coupled with the weight of oxide acted upon. Some idea could then be formed as to the quantity of air required per ton of oxide; and then it would be a simple matter to arrange for the supply of this quantity.

Mr. Riley thought the particulars given in the paper seemed to point to the fact that the actual volume of air passed through the purifier was of no practical consequence. The actual application was most simple. The purifier was shut off, the air-pipe connected, and air forced in at the highest pressure practicable. It was rather a question of the number of hours required for the revivification of a purifier than of the quantity of air admitted. The plan would be very useful in works where the purifiers were small in area; and he would be glad to know if it would be safe to increase the pressure, and so hasten the time occupied in revivifying, to a greater extent than Mr. Dexter had carried it. Referring to the third experiment carried out by the author of the paper, he asked if the narrow band of unchanged material shown in the drawing possessed any physical peculiarities—in other words, if the material was more dense or closely packed at that part.

Mr. Brierly thought the experiments described were of an interesting character, particularly with regard to the property of the material to revivify downwards. Every chemical association required a certain minimum of time for working. The greater the pressure, the greater would be the penetrating power of the air into the oxide. Another point was the effect of friction as regards the action at the bottom of the box, compared with that towards the top. Friction meant increase of temperature; and this, in its turn, meant greater chemical activity. The temperature would be higher towards the top of the box; and perhaps this was the reason of the more active operations that evidently prevailed there. As to the quantity of air required, this would depend not only upon the weight of oxide to be revivified, but also upon the efficiency, as shown by the percentage of oxygen actually absorbed, which could be ascertained by analyzing the air escaping from the plug, besides which there was the effect of pressure. Possibly a greater efficiency obtained at the higher pressure. The slower the velocity of the current of air, the smaller the percentage of unused oxygen that would escape.

Mr. A. STEPHENSON (London), in response to the invitation of the President, said that in revivifying *in situ* the real question was the percentage of sulphur contained in a combined form in the material; or, in other words, the percentage of sulphide of iron. An important consideration in connection with this matter was the liability of the oxide to heat during revivification. This varied according to the age of the material; and new oxide was more likely to fire than that which had been used for some time. Unless the air was admitted cautiously, the material would become hot, and the grids would be burned. He had known the plan described to be tried at several places, but rejected on account of this liability to heat. Then some preferred to admit a small percentage of air with the gas; and certain of his friends claimed to be able to use as much as 4 per cent. of air without spoiling their gas. But he thought in that case the air must be of very superior quality. He considered that Brin's oxygen process presented by far the best means of revivifying *in situ*. Perhaps Mr. Dexter could say something about the age of the oxide he used.

The PRESIDENT thought the meeting had heard a good paper, and some practical remarks upon it. He had had no experience himself in revivifying by blowing air through the purifiers. It would be a good thing if some regular rule or plan for revivifying *in situ* could be arrived at; and the use of pure oxygen was certainly far in advance of air.

Mr. DEXTER, in reply, said that no doubt the question raised by Mr. Humphrys, and subsequently by Mr. Thomas, as to the quantity of air required, was interesting; but he did not think it was of any practical importance. No one ever troubled about the volume of air that came in contact with the oxide in the revivifying-shed. He had aimed at bringing the air to the oxide instead of taking the oxide to the air; and he really could not get at the volume of air sent through the purifier. As to the limit of pressure, he saw no reason why any pressure short of forcing the lutes should not be used. As already explained, he was unable to obtain a higher pressure with the blower at his command; otherwise he would have tried an experiment at 6 inches pressure. He did not think the friction between the air and oxide could be of much account, though the question of temperature was undoubtedly of importance. In the second and third experiments, though the pressure was greater, the actual velocity and quantity of air passed was greatly reduced. In reply to the question about the narrow band of black in the third experiment, he did not notice any difference in the hardness of the oxide at that point. Every chemical action required time; and at the highest pressure any given particle of air remained in contact with the oxide for the longest period. The percentage of sulphur in the oxide he used was 20; and it was raised up to 50 in the test-box by the repeated experiments. The tendency to heat was greater as the percentage of sulphur increased; and in the last few operations he had to reduce the velocity of the air somewhat, so as to keep down the tempera ture. The heating was entirely under control. No doubt it was possible to blow up the box, or set the whole on fire; but there was no need to do so. It was merely a matter of adjusting the air supply.

VOTES OF THANKS.

Votes of thanks were then accorded to the readers of papers; to the Directors of the Southampton Gas Company and Mr. C. Crowther Smith, the Secretary, for the kind and hospitable reception extended to the Associatien; and to the President. These having been duly acknowledged, the meeting closed.

Before leaving, the members were served with tea, &c., by the kindness of the Directors of the Company.

EASTERN COUNTIES ASSOCIATION

HALF-YEARLY MEETING, MARCH 19.

This Meeting was held in the historical Guildhall at Lincoln. At the commencement of the proceedings, the outgoing PRESIDENT (Mr. J. Barton, of Peterborough) occupied the chair.

AN OFFICIAL WELCOME.

The MAYOR of LINCOLN (Mr. E. Pratt) was introduced to the meeting by the President, and, on behalf of the citizens, offered the members a hearty welcome.

Mr. W. T. PAGE, Chairman of the Gas Committee of the Corporation, was also introduced, and briefly addressed the meeting. In the course of his remarks, he said it was only five or six years ago that the Corporation became the owners of the Lincoln Gas-Works, which had previously been successfully carried on by a private Company. The acquisition of the works by the Corporation arose in consequence of the Company applying to Parliament for extended powers with reference to capital; and at the same time they desired to be placed under the sliding scale. The Corporation thought it their duty to find out what would be the effect of the sliding scale upon the consumers of gas; and it was found that the shareholders would have been able by it to pay at once an increased dividend. Negotiations then took place between the Corporation and the Company, with the result (he was speaking from memory) that the shareholders were assured their maximum dividends in perpetuity; and he thought the city had no reason to be dissatisfied with the bargain. Speaking with reference to the policy which the Corporation had adopted in regard to the gas undertaking, he said that, of course, as far as the Committee were concerned, they were at first pure novices in gas matters; and personally he did not know a great deal now. It was suggested to the consumers that, if the Corporation purchased the works, there would be a reduction in the rental paid for meters, which was then 1s. per quarter. The further hope was dangled before their eyes that the Corporation would be able to produce and supply gas considerably cheaper than the Company. It was a great deal in favour of Mr. Carter, their excellent Engineer, when he said that these results were accomplished in a very short time; for whereas in the case of many other undertakings the price of gas had been increased; in Lincoln they had been able to reduce the meter-rents to 6d. a quarter, and the price of gas to 2s. 6d. per 1000 cubic feet—a price which must be eminently satisfactory to the purchasers of the commodity. The Committee urged upon Mr. Carter that the gas he produced should not only be cheap, but of the very best quality and of the greatest purity: and it seemed to him (Mr. Page) that if the proprietors of gas-works were to hold their own, and to discharge the duty they owed to their consumers, they must see that the article they supplied was beyond question as regarded its illuminating power and purity.

Mr. C. E. Jones (Chesterfield), in proposing a vote of thanks to Mr. Page for his remarks, said it was very gratifying to the members to hear how successfully the Lincoln Gas-Works had been managed. If it were otherwise, they would have been somewhat disappointed, knowing what manner of man Mr. Carter was, and also the great ability and assiduity he brought to bear upon the duties he had to perform. They had to congratulate Mr. Carter on possessing such a very able Chairman as Mr. Page.

The motion was carried by acclamation.

Minutes of Last Meeting.

The Hon. Secretary (Mr. H. Wimhurst, of Sleaford), then read the minutes of the meeting held at Great Yarmouth in September last year, which were confirmed.

Election of New Members.

On the proposition of Mr. Jones, seconded by Mr. F. Weller (Southtown, Yarmouth), the following gentlemen were elected members of the Association: Mr. C. Panchen, of Yarmouth; Mr. J. W. Portass, of Bishop's Stortford; Mr. C. G. Grimwood, of Sudbury; Mr. J. Mason, of Oakham; Mr. H. D. Duesbury, of Cambridge; and Mr. Brooke Gibson, of Haverhill.

Annual Report.

It was agreed, on the motion of the President, seconded by Mr. T. Greaves (Melton Mowbray), that the annual report of the Committee should be taken as read. It was as follows:—

Your Committee have pleasure in presenting their second annual report to the members of the Association, and express satisfaction at the progress made by so young an institution. Two half-yearly meetings have been held—the spring meeting at Peterborough, and the autumn meeting at Yarmouth.

The number of members on the 1st of January, 1890, was 39; 10 new members were elected during the year; and 5 members resigned—leaving the number of 44 as members on Jan. 1, 1891, which number, the Committee hope, will be largely increased in the near future.

The balance-sheet shows that the year began with £7 8s. 3d. in hand; and subscriptions were received amounting to £26 6s.—a total of £33 14s. 3d. The expenditure has been £17 9s. 8d.; leaving a balance in hand at the end of the year of £16 4s. 7d., and only one subscription outstanding.

At the spring general meeting, the President (Mr. John Barton) delivered his Inaugural Address, which was of great interest to the profession. Mr. W. Drewry also contributed a paper upon "Experience with Subsided Gas-Mains," from which proceeded a good discussion. The members then made an inspection of the Peterborough Gas-Works, and also of the Cathedral; afterwards dining together.

The autumn meeting of the Association was held at the Town Hall Yarmouth, when practical papers were read by Mr. James Lees and Mr. J. E. Buckle—on "How to Maintain and Increase the Popularity of Gas" by the former, and on "General Matters connected with the Working of Small Gas-Works" by the latter gentleman Both papers were fully discussed by the members. Mr. John Carter was elected President; Mr. A. Mead, Vice-President; Mr. H. Wimhurst, Hon. Secretary and Treasurer; and Messrs. A. Mitchell, E. J. Brockway, and C. W. Grimwood, on the Committee for the ensuing year. Upon the conclusion of the business of the meeting, the members took lunch together; afterwards visiting the works of the Great Yarmouth and the Gorleston and Southtown Gas Companies, over which they were kindly conducted by Mr. W. J. Carpenter, Engineer of the former Company, and by Mr. F. Weller, Engineer of the latter Company. The members then proceeded by coach to Somerleyton, and visited the grounds of Sir Saville Crossley, Bart., M.P., whose kindness was much appreciated; returning to Yarmouth to dinner, under the presidency of the President, supported by the Mayor of Yarmouth and the Directors of the Gas Companies. The thanks of the members are due to Mr. W. P. Brown, Mr. W. J. Carpenter, and Mr. F. Weller, for making the local arrangements for this meeting, which one and all so much enjoyed.

The thanks of the Committee are due to those gentlemen who have supported the work of the Association by the reading of papers; thereby rendering great service in promoting knowledge which must be of benefit to the members generally.

The Committee hope that each member will use his influence on behalf of the Association, in the reading of papers and by inducing other gentlemen to join in the work of the Society by becoming members.

THE NEW PRESIDENT.

Mr. **BARTON** said the time had now arrived for him to leave the chair; but before doing so, he wished to thank the members for the assistance they had rendered to him during his year of office, and also the gentlemen who had contributed papers at the meetings. He must also thank their esteemed Secretary; for he had made the work of the year very light, and had been indefatigable in carrying out his onerous duties. He wished Mr. Carter every success, and trusted that the kindness and courtesy which he had personally experienced would be extended to him, and that, at the close of his term of office, they would be able to look back on a profitable and interesting year.

Mr. J. **CARTER** (Lincoln) then took the chair amid applause, and proceeded to deliver the following

INAUGURAL ADDRESS.

In addressing my observations to you from the presidential chair, allow me at once to express my deep sense of the honour you have conferred upon me. It will be my duty and privilege to serve the interests of the Association during my year of office to the best of my ability; and when, at its close, I relinquish the dignity and responsibility of the chair, I shall be satisfied if I have earned the verdict of your approval.

I do not claim for my remarks that they are likely to contain anything new to you; but I propose to refer briefly to some of the circumstances which at the present moment are of interest to us as an Association of Gas Managers. It may be said, I think, that the matters of the greatest importance to us, and which have during the past year most deeply affected the interests of the industry with which we are connected, are of an external rather than of an internal or technical character. One or two subjects of the latter description, however, may be worthy of passing notice.

In the early months of last year, the new principles with regard to the guide-framing of gasholders which are associated with the name of Mr. W. Gadd, were put to the test of practical working, when a new double-lift holder was erected at Northwich; the usual upper guides being entirely dispensed with. The wire-rope system of Mr. Pease has also received its share of attention. As far as experience enables us to form a judgment, we have no reason to doubt the success of the new inventions; and those gentlemen, by their industry and skill, have laid not only managers, but proprietors of gas undertakings under great obligations to them. You all know perfectly well what a large proportion of the expended capital of a gas undertaking is absorbed by the holders. Speaking generally not less than one-sixth of the entire capital outlay is spent upon this part of the plant; and in smaller works the proportion will reach one-fourth. Such a material diminution in the cost of these vessels as is effected by the new system, will prove of great benefit to us. Capital charges constitute a most potent factor in determining the commercial success of any industrial concern; and with regard to our own, this is a decided step in the right direction. It is not simply a modification; it is a revolution in gas-holder construction, and is in itself sufficient to mark the past year, and make it memorable.

The year will also be remembered as that which witnessed, if not the introduction, at any rate the adaptation of the principle of the inclined retort. As it has not yet passed out of the experimental stage, it is too early to say whether it will generally replace the horizontal system with which we are all familiar. In several places the inclined retort is being, or is about to be, subjected to a practical test; and we shall await the result with great interest. Such a complete modification of the conditions of carbonization as will obviate the heavy and exhausting labour which at present characterizes our retort-house work, will be well worth the additional cost the new settings involve.

In the face of the competitive lighting agencies which we have to meet, the industry generally, judging by the published reports, is in a very sound and satisfactory condition; and a large extension of business, partly accounted for by the exceptionally severe winter through which we have recently passed, is the general experience of gas managers. Upon the first introduction of electric lighting into this country, the gas industry was thought by some to be threatened with speedy extinction. The value of its securities fell to a very considerable extent; and apparently the impression seized the minds of not a few that gas was one of the resources of civilization which was about exhausted, and would very shortly be regarded only as a relic of the past. How completely these prognostications have been falsified, is matter of history. The growth and development of gas manufacture throughout the country since that time is striking. Taking the figures contained in the Board of Trade returns for 1882 and 1889 as the basis of comparison, the tonnage of coal used in the manufacture of gas during that period increased from about 7¼ millions to rather more than 9½ millions per annum—equal to 32 per cent.; and the make of gas shows an annual increase of 35 per cent. One very satisfactory feature in connection with these facts is, that even in districts where the electric light has been most largely adopted, the development of the business of gas undertakings has not, to any appreciable extent, been impeded. Gas and electricity appear to grow side by side.

More than this, the manufacture of gas is conducted under much more improved conditions than obtained twelve or fourteen years ago. The coal is carbonized with a less expenditure of fuel, and better results are being obtained. Managers were satisfied with a make of 9000 cubic feet to the ton even in fairly large works; but now we are not content unless 10,000 cubic feet to the ton are accounted for in the rental. The selling price, owing to the improvement in manufacture and the extension of business, has during these years been materially reduced. In addition to all this, we have now much better appliances for the consumption of gas; and, owing to the labours of Siemens and others, we may be supplied with burners by which a duty of 10 candles per cubic foot can be obtained from gas having a photometrical value of from 16 to 17 candles. These facts are interesting in themselves; but, taken together, they indicate that, commercially considered, the gas industry is in all respects in a much stronger position than formerly, and therefore better able to maintain its ground among the various competing illuminants occupying the attention of the public.

If this position is to be maintained, a low selling price is an indispensable condition. That the quality of the gas supplied must be satisfactory, both with regard to its illuminating value and its purity, goes without saying; but consistently with this it cannot be too strongly urged that our chief element of strength lies in the cheapness of the article we manufacture and supply. Given a low selling price, we can successfully compete with other illuminants, and may with confidence expect an increased demand for domestic and industrial purposes.

However deeply convinced the manager may be of the policy of supplying cheap gas, and however desirous to do so, present conditions are certainly not favourable. We have within the past eighteen months experienced an unexpected rise in the price of coal, in many cases amounting to from 4s. to 5s. per ton; and the manufacturing cost of gas has been increased at once by 6d. per 1000 cubic feet. It is true that coke has realized higher prices; but the value of other residual products has not been to any appreciable extent enhanced, and so the greater part of this extra charge falls upon the undertaking. The question which exercises our minds just now is, Will coal maintain the high price at which it now stands? After the experience of the past two years, he would be a bold man who would venture on such a prediction. Last summer we heard a great deal concerning a supposed ring formed by the gas-coal owners of a certain district; and in all probability some sort of an arrangement existed, the purpose of which was to secure higher contract prices than, in our opinion, the circumstances justified. The combination to some extent succeeded; but though such a movement may temporarily occasion much inconvenience and expense to those in the market, it cannot in the nature of things exist for any length of time. The ordinary conditions of trade, which really determine commercial values, will inevitably assert themselves. Probably we shall see some reduction in the price of coal; but there are no present appearances which warrant us in expecting a return of the exceptionally low rates which prevailed two or three years ago. As far as I am able to judge, that is placed out of the range of probability by the increase of miners' wages and by the equilibrium which has apparently established itself between the supply and the demand.

Another phase of the coal question has been brought prominently before us recently, in the difficulty of obtaining regular and adequate supplies. It is now the inevitable practice of coal-owners to protect themselves against any liability to deliver during strikes, and to insert in the contract notes a special clause for that purpose. The gas manager, therefore, who would face the winter season free from anxiety with regard to his supply of coal, must make provision for larger stocks than were, under more settled conditions, necessary. A month's consumption in midwinter should be the minimum store, and where possible even double this quantity. This may require, in some cases, considerable outlay in providing storeage accommodation, and in all cases would involve the employment of a larger amount of working capital. But it is far better to spend in this manner and be safe, than to incur the expense of rushing into the market in the midst of a panic, and bear the strain and anxiety which a failing coal supply invariably occasions.

Another element of a disturbing character is to be found in the unsettled relations between employers of labour and their workmen. As one of the great industries of the country, gas-works have been directly affected thereby. In the district covered by this Association, we have, scattered over a wide area, a large number of small works; therefore the labour question is not of such vital personal interest as in other parts of the country. Nevertheless, I would take this opportunity of stating my conviction that, in the interests of capital and labour alike, some method of settling industrial disputes might, and ought to be adopted, other than the barbarous, inconvenient, and to all concerned, very costly mode of resorting to strikes, of which we have had, during the past year or two, so many deplorable examples. It is a matter for congratulation that Her Majesty's Government, sensible of the great evils which are associated with, and arise out of, these frequent conflicts, have appointed a Royal Commission to inquire into the whole labour question. If their action eventuates in the adoption of some method which will provide for the settlement of labour disputes, without recourse to open rupture, they will render to the commercial interests of the country a service of the most extreme value.

Industrial wars, like national wars, seldom produce a satisfactory solution of the questions in dispute; but often create great bitterness, and sometimes leave behind them conditions which lead to further trouble. They are costly alike to master and man, and productive of great inconvenience to the public generally. More than this, strikes in gas-works, while they frequently involve the men and their families in much suffering and privation, may have a disastrous effect upon our business. Gas as an illuminant is popular. In the home, for cooking and heating, and in the workshop, for motive power, it is becoming increasingly popular. But if, owing to labour disputes, the public confidence in the regularity of supply is destroyed, we shall impede the development of business in this direction, even if we maintain the ground already occupied. For this reason, strikes should, if at all possible, be avoided. Personally, I should be pleased to see the Council of The Gas Institute taking action with a view to the establishment of a Board of Conciliation for the prompt adjustment of any difference which may arise in connection with the labour question as it concerns gas-works; and I hope that such action will not be regarded as beyond the range of practical politics. A Board composed of a number of gentlemen of high character and position, representing the employer, and an equal number of representative workmen, would, in my opinion, under all circumstances, be quite competent to arrange any matter of contention which might arise. At any rate, in other industries we are not without examples of the successful operation of such a representative authority as that I suggest.

The question of railway rates is also worthy of special notice, and may, to a serious extent, adversely affect the gas interest in common with others. I need make no further apology for referring to this matter than to state that the freight bill of an average gas-works will exceed the total amount paid for labour in all departments; and in this district it amounts, at a moderate estimate, to from 6d. to 9d. per 1000 cubic feet of gas made. Any proposed increase in these charges becomes a very serious matter. In the schedule of rates and terminal charges, which is still under discussion, the railway companies seek parliamentary sanction to certain maximum charges, which are much higher than those in force at the time the schedule was prepared. As the result of a protracted inquiry ordered by the Board of Trade, the original schedule has been revised, and considerable alterations and modifications made. The revised schedule is strongly opposed by the companies; and the question has still to be fought out in the Parliamentary Committee-room. We cannot afford to regard these proceedings with indifference; nor can we object in principle to the application of the companies for standard maximum rates. In connection with the undertakings we represent, we have maximum prices, which have been fixed by legislation. But in our case the interests of the public are safeguarded by the well-known provisions of the Gas-Works Clauses Act, 1847, which limit the dividends payable by gas companies, and empower local authorities, under certain conditions, to compel a reduction in the price of gas. It is not so with railway companies, although in many districts they possess a complete monopoly. This is not a matter of great importance to those among us who are fortunately placed at competing points. Where two or more railway lines run into the same town, competition will certainly operate to prevent the imposition of excessive charges; but in many places in the Eastern Counties, where our friends are entirely in the hands of one company, they will be subject to whatever charges, within the maximum, the railway authorities may determine to exact, and my experience convinces me that the impost will not be likely to err on the side of moderation. The result of the agitation may be a schedule of rates to which no reasonable exception can be taken, as the various commercial communities are fully alive to its importance, and powerful organizations are acting in the general interests of trade. In our own industry the managers in the Midland district have taken it up, as it affects their particular neighbourhood; and I hope we shall have no occasion to regret that this action was not more general.

These are the principal difficulties which, at the present moment, threaten us. At one time they would have been met by the ready method of increasing the price of gas. Happily we have come to regard this step as detrimental to the business with which we are associated. Just in the proportion that we raise our price, we weaken our position, and play into the hands of our competitors. The sounder policy is to encourage and develop the use of gas for general purposes, as a means of enabling us to avoid the necessity of an advance in the selling price. Something has already been done in this direction; and we have been in the habit recently of congratulating ourselves upon the success of our efforts. We hear of 10, 15, and 30 per cent. of the consumers in a given district adopting gas as a means of cooking, and the summer consumption increasing by 20 per cent. This is satisfactory so far as it goes; but we have only touched the fringe of the question, and a wide field is ready for cultivation. Gas-cooking stoves are still, in the main, the luxury of those in easy circumstances; it is our business to make them a necessity in the humbler home of the artizan. Given cottage cookers, substantially made, and at a moderate cost, fixed at a nominal rental in the homes of the working classes, and we should discover opportunities for popularizing the use of gas to an extent not yet realized. We are too much in the habit of supposing that exceptional precautions are necessary with the smaller consumers to insure payment of the accounts when due; and so, whenever this subject is discussed, it is always in connection with deposits, prepayment meters, weekly or monthly collections, and the like. I question the necessity, and altogether dispute the policy, of such steps. We recognize that a greater spirit of enterprise should be introduced into our administration; but we should also be prepared to take the risk which is associated therewith. With regard to this class of small consumers, my opinion, founded upon experience with thousands of them, enables me to state that the risk will be no greater than with other classes. I have upon my books a great number of working men consuming from 8000 cubic feet to 10,000 cubic feet per annum. The accounts are collected quarterly, are paid regularly, and with exceedingly little loss. I am satisfied that a bold policy in this particular presents great opportunities; for while maintaining the pre-eminence of gas as an illuminant, its establishment as a necessity in the houses of the masses for domestic purposes would place our industry in an impregnable position.

Mr. J. Hepworth (Carlisle) proposed a vote of thanks to the President for his exceedingly able address. He had heard a good many addresses of a similar character, but he did not think there had been one which had interested him so much.

Mr. Barratt, in seconding the motion, alluded to the remarks made by Mr. Page early in the proceedings. He said it was quite right that gas should be made cheap and good; but he did not think that corporations should arrogate to themselves the credit of making gas cheaper than private companies. The Lincoln Corporation were certainly much larger than the Grantham Gas Company; but the members would not be very much surprised when he told them that they delivered gas at the same price in Grantham as they did in Lincoln, notwithstanding that the make in Lincoln was some three or four times more. Though he might be charged with egotism, he could also say that his gas was quite as good.

The President briefly acknowledged the compliment.

Vote of Thanks to the Ex-President.

Mr. Jones moved a vote of thanks to the Ex-President for the satisfactory manner in which he had performed his duties during the past year.

Mr. C. W. Grimwood (Sudbury) seconded the motion, which was carried with applause.

Mr. Barton acknowledged the vote in a few suitable words.

Mr. Barratt then read a paper entitled—

SOME THOUGHTS ON GAS-METERS.

The importance of the subject I have chosen must be my apology for appearing before you to-day with this paper. Year after year papers have been read at meetings of Gas Associations on almost every matter connected with the manufacture of gas—retorts, ascension-pipes, hydraulic mains, condensers, purifiers, scrubbers, &c. But comparatively few engineers have treated upon the machine that measures, or is supposed to measure, the gas delivered to the public. True, the late Mr. F. W. Hartley read a valuable paper on "Gas Measurement," at the meeting of the British Association of Gas Managers in Dublin in 1871. Mr. Hartley then gave his reasons against the use of dry meters, and explained his reasons for preferring wet meters. An interesting discussion followed, in which Messrs. Warner (of South Shields), Spice, and Anderson (of London), took a prominent part. The subject was not referred to again till 1874, when Mr. Warner read a paper, which will repay perusal, on "Wet Meters," at the meeting of the British Association.

In 1875 the British Association held its annual meeting in the hall of the Philosophical Society, Leeds, under the presidency of our old friend, Mr. James Paterson, F.G.S., of Warrington. At that meeting a paper was submitted by Mr. J. Douglas, of Portsea, on the "Systematic Testing of Consumers' Meters." A very lively discussion followed, in which I took part. Those who wish to understand the vagaries of dry meters will be amply repaid by a perusal of Mr. Douglas's paper, as some interesting statistics were furnished. At the meeting to which I allude, I made the following remarks:

> I did not speak merely as a gas manager, but as having been the meter tester for five or six years for the Corporation of Leeds. During that time 10,000 meters, wet and dry, passed through my office. A long time before I left the service of the Corporation, my faith in dry meters had entirely disappeared; for I never found one dry meter that would register the same under all circumstances. Take a two or three light meter, and test it under 5-10ths pressure; and it might be found to register within 5 per cent. of the quantity it was marked to pass. But pass through that meter from 12 to 18 cubic feet of gas, and it would vary. If 18 cubic feet were passed, it would be from 5 to 6 per cent. slow; if the same quantity of gas was passed through it at a slower rate, it would be found to be what it was alleged to be when sent out from the manufactory. On one occasion, I wrote to Mr. Joseph Adamson, one of the first Presidents of this Association [the British Association of Gas Managers], stating there was not a dry meter that had come under my own observation through which I could not get as much gas, without any registration, as the meter was sent out to pass. This statement was communicated to a dry-meter maker, who came to me, and said he would undertake to make a 10-light test-meter that should be absolutely correct under all circumstances. This was arranged accordingly; and a clause was put in the agreement, that the meter was not to be paid for until certified by me to be correct. The meter came down, and was put through several tests; but, before the testing was over, there was a variation of registration, as against the gas company, of no less than 7½ per cent. The firm was never paid for the meter, and that meter is still in my possession. I had then been in my present situation about twelve months. When I first went to Grantham, I tried to ascertain the leakage in the place, and, to my astonishment, found it to be 25 per cent. I was certain that this 25 per cent. could not go through the mains in the streets; and I therefore proceeded to discover the proportion of dry meters to wet throughout the town, when, to my great sorrow, I found that I was up to the shoulders in dry meters. At Christmas last I took the inspector's book and found no less than 20 dry meters standing which had not registered anything for the three months previously. I then went to the rental, and found there that they had not registered one-half the consumption of the prior quarter. At the close of the next three months, the inspector's book showed that ten more meters had stopped; so that, out of 1400 meters, there had been stopped, in six or nine months, no less than 30. I followed the last-named meters backwards, and found that they had been like their fellows in the quarter before, they had stopped. On the other hand, I must mention that, during the whole of the time, very few wet meters had come under my notice which were not within 2 or 3 per cent. of being correct.

Since making the foregoing statement, I have seen no reason to alter my opinion, except that a more extended experience has caused me to have less faith than ever in dry meters. At the same time, I do not deny that in some places, and under some circumstances, there may be some advantage in having a dry meter.

A short time ago a pamphlet was sent to me by post, and I must confess on reading it I was astonished that such a pamphlet had been forwarded to any intelligent gas engineer or manager. Did the author think that gas managers in the Eastern Counties had prepared themselves for a six months' incarceration in Bracebridge? or that they had bid good-bye to their common sense? or that they had thrown their judgment and experience on the neck of chance? I regarded the pamphlet as an insult to us all. It contains little that is new; and much that is contradicted by everyday experience. The author states that, under certain conditions, a wet meter can be adjusted to measure accurately; and every manager of gas-works, worthy of the name of manager, knows well and sees that the conditions are complied with. Here the fact is admitted that a wet meter can be made to register correctly; and this is more than I dare to say of a dry meter. It is stated that wet meters are used for experimental purposes with the photometer. This being admitted, why, if the dry meter is the best, the most accurate, and the steadiest when at work, is not a dry meter used for testing purposes? This is rather significant. But let me go further, and let me ask if it is not true that every test-holder passed and stamped by the Government Department is, without exception, a wet meter. Then we are told that gas companies using wet meters exclusively may lose 10 or 20 per cent.; but it may be said with equal truth that they may not. In my own case, I am sure I do not; and I believe there are other companies who do not suffer by their use. Then, again, we are told that it can be proved, from the books of certain companies, that a very large increase of gas rental is caused by substituting dry meters for wet. The books of my Company prove the reverse, as our rental has increased by substituting wet for dry meters; and, further, the price of gas has been reduced from 5s. per 1000 cubic feet to 2s. 6d. per 1000 cubic feet, at which price it stands to-day, and we do not deliver a less quality than 16 to 17 candles. Then, as to the recent frost, we have about 2000 meters in use in the town; and out of this number only from 2 to 2½ per cent. caused us any trouble, and in many cases we found it was the service-pipes that were at fault, and not the meters. We had no station without gas; no churches, chapels, or public rooms. Give me a good wet meter; and I will run the risk of deficient services.

But it may be asked whether dry meters do not register fast as well as slow, and whether the one does not balance the other? I answer, "Certainly not." If this were the case, the element of unfairness to the consumer would come in. No company should depend upon averages for their revenue. It would be immoral to continue to work under such conditions. What right have we to make Mr. Jones pay for Mr. Brown? Is there anything more calculated to cause dissatisfaction than a system of this description? The man who attempts to work it is not wise. A customer of mine became dissatisfied with his wet meter. He thought it registered too much, and expressed his desire to have a dry meter in its place. I ordered the meter to be changed. A few months afterwards I met this customer, and he then informed me that his gas bill was larger than before, and that he should like his old wet meter back, which was done.

But I am told all objections can be overcome by a constant and systematic testing of dry meters. On the assumption that this can be done, what will be the cost of furnishing a room with a test-holder and all its fittings? Our friend, the President, and perhaps a few others, might be able to do this; but it is beyond the power of others. If they cannot get the necessary apparatus, what are they to do? Their only plan would be to send the meters to the nearest testing-station and have them tested, and if correct, returned. But if found incorrect, what then? They would require to be sent to a meter repairer, and that means a pretty little bill. Why are we to have this inconvenience and cost with dry meters when we can have a meter that does not necessitate such trouble and expense? There can be but one reason, and that is to keep dry-meter manufacturers in work repairing their own meters.

A great deal of sympathy is professed for our friends in the North; but I am quite sure they are wide enough awake to take care of themselves. Mr. Johnson, of London, stated, at the Leeds meeting in 1875, that "the wet meter was undoubtedly the most accurate instrument. It could always be depended upon; and he scarcely knew an instance in his experience, with 1000 or 2000 he had tested, in which a wet meter had allowed gas to pass unregistered." Mr. Helps, of Bath, stated that "during the last six months the trouble and worry they had had with stopped dry meters was something more than he could tell; sometimes the thing had continued for two or three quarters without notice of the inspector. There was not only the loss thus occasioned, but the discontent engendered among the consumers, who could hardly be persuaded to believe they had had gas which had not been registered." Mr. Foulis, of Glasgow, said "he had in his city something like 160,000 meters, 75,000 of which were two-light meters. Five years ago he had no less than 20,000 dry meters number nothing. Half his meters were wet and half dry; and he was perfectly certain that, for every single wet meter taken down for non-indication, he took down ten dry meters. During every inspection, 30 or 40 dry meters were brought in daily, simply for doing nothing, though very often the mere shaking of them would make them all right. He had no hesitation in saying that small dry meters were a very great source of loss."

Evidence like this, coming from such practical men, is worth tons of pamphlets sent from interested dry-meter makers. But no matter where they come from, my experience tells me there is little difference between the instruments of different makers. I believe one is as good as another.

After forty years' experience, such as few men in the profession could have had, I say, "Give me a good wet meter and a good inspector, and I shall obtain all the gas I make within 6 per cent.; and if so I shall be able to supply gas at 2s. 6d. per 1000 cubic feet." I have not written this paper with the intention of exhausting the subject, but to provoke a good discussion; and I hope every man who has anything to say will now say it, or for ever hold his peace.

Discussion.

Mr. F. Weller (Southtown, Yarmouth) said that he had very little to remark on the subject brought forward by Mr. Barratt. At present he had no wet meters; and he did not intend to have any if he could possibly help it, as he knew it meant a good deal of extra work. In his district he had reduced the unaccounted-for gas from 20 per cent. to 7 per cent.; but he had no wet meters. They would be all right perhaps if a good inspector was employed, and a little boy to run round to water them. The only wet meter he had was his station meter; and that he had to wrap up in the winter, besides using a gas-stove, to keep it warm. (Laughter.) He should even take care that the next station meter he had was a dry one.

Mr. C. W. Grimwood (Sudbury) said there was one side of this question which was not touched upon by the reader of the paper or by Mr. Weller—that was, the consumers' view of the matter. The consumers, he held, should be studied as much as gas managers studied themselves. His practice with new consumers had been this: When one came to him, he asked him whether he would like a wet or dry meter. If he preferred the former, he put a wet one in; but if he left the choice with him (Mr. Grimwood), he supplied a dry one. This plan, he thought, saved the gas manager a lot of trouble. They were not all in the position of Mr. Barratt, who could have as many inspectors as he chose to look after the meters; and for his own part the fewer wet ones he had, the better he liked it, as it gave him less to do. He thought it was the duty of meter makers to produce a good dry meter—one that was as good as any wet meter; and if they could not do this, it was time they gave way to a new race of manufacturers. But his experience was that dry meters were as good as wet ones; and he should pin his faith to them. It was very important that gas managers—especially in small works where a large staff was not kept—should see that their meters were maintained in good condition. He believed that meter manufacturers would send men to any small gas-works, with proper appliances (which could be fitted up in an ordinary room), and, for a very reasonable charge, they would test all the meters in the town. He thought this was a wise thing for gas managers to have done periodically.

Mr. W. **Duesbury** (Cambridge) said he had used both wet and dry gas-meters. As a correct measurer, he preferred the former; but, on the other hand, he was not particularly in favour of using them if they were more troublesome than dry ones. In Derby, where he formerly was, they had about 16,000 meters, among which he did not think there were 100 dry ones; but at Cambridge, where he was now, they had not a dozen wet ones. He believed, however, that more of these dry meters stopped registering than there would be if they were all wet ones; but he admitted that they saved a good deal of the expense which was involved in attending to wet meters in frosty weather. He might say that, as far as he could remember, the loss of gas both at Derby and Cambridge, was about 5 per cent. There was something to be said in favour of each class of meter; and so they should be slow to condemn either. They were both useful instruments; one kind being of more use than the other in different places.

Mr. W. H. **Manwaring** (Lincoln) said that Mr. Barratt had referred to Mr. John Douglas's paper read before the British Association of Gas Managers in 1875; but he omitted to state that that gentleman quoted some statistics which were supplied to him by Mr. John Field, who was then the Accountant of the Imperial Gas Company. These figures showed that the Company had about 70,000 dry meters in use in 1874; and that the testing of them during the three previous years revealed the fact that the total effect on the rental by defective meters was not more than 0·008 per cent. Of course, previous to that time the meters were periodically inspected, and so kept in a state of repair. Mr. Barratt had also omitted to mention some of the evils that were inherent to wet meters. He (Mr. Manwaring) had syphoned water from a wet meter until it flew from the index-box without the float dropping. If the water had evaporated to such an extent that it unsealed the inlet-pipe, a serious explosion might have taken place.. These risks were entirely done away with in a dry meter.

Mr. E. J. Brockway (Cleethorpes) said his experience as a gas manager was that both wet and dry meters had their places under different circumstances, but Mr. Barratt had made a most sweeping denunciation of the latter. Take two extreme places in a district. In one town the gas company did the fitting work, or at least had control of the fittings; and in the town they had all wet meters. They had the meters placed in low and comparatively cool places, and they saw that the pipe in each house was laid with a proper fall to the meter, and that a syphon was conveniently placed for catching the condensed water. Under conditions like this, the registration of a good wet meter, say with a compensating arrangement, or a Warner and Cowan drum, was all that could be desired. But in the other town, the speculative builder ran riot; and houses were put up as cheaply as possible. The commonest gas-pipes that could be obtained were fixed along the walls of these houses; and after a time they began to sag. Then the meter would perhaps be placed in a cupboard close to the kitchen range; the result being that a wet meter in a house fitted like this was a perfect nuisance, and the gas company had either to take it out and put in a dry one, or lose a consumer. As to the manufacture of meters, there was no doubt that a dry meter required considerably more care in its construction than a wet one. The diaphragms had to be selected from the finest skins; and great care was necessary in sewing the ends so that the needle should not puncture right through. The valves, too, often got a deposit on the face in a little time; and this allowed a small percentage of the gas to go unregistered. If wet meters were used, they should be attended to at intervals of six weeks, or at least once a quarter; and in the case of dry meters, after the first five years, they should be taken out and tested periodically—at least once in two years. If this was done, he believed the percentage of unaccounted-for gas would not be more than in places where wet meters were used.

Mr. A. Drage (East Dereham) said that in his district he had mostly wet meters; but it was interesting to notice that during the recent frost he had only one dry meter stop, as against twenty wet. In the *Journal of Gas Lighting* for Feb. 18, 1890, it was reported that they had lost more than 20 per cent. of gas. He asked the Local Board at the time to have all the meters tested. This they did; and it was found that the dry meters (they had only about 20 out of 300) were all correct, but some of the wet ones were as much as 100 per cent. slow. (Laughter.) However, they had not been tested for a good many years. He was now pleased to be able to say that he had reduced his unaccounted-for gas very considerably; in the past quarter, it only amounted to 4 per cent.

Mr. C. E. Jones (Chesterfield) said that he had hoped that these old trade controversies had been relegated to the "limbo of the dim and misty past." But their friend Mr. Barratt was nothing unless he was original; and coming as he did of a fighting stock from Yorkshire, it was not at all surprising to see him on the "war-path" of the dry meter makers. He thought that this question of meters had been completely thrashed out at Leeds; and it was a great pity that trade jealousies should have stirred this mud up again. He failed to see what purpose was served in bringing it up periodically, because it only led to prejudice against the sale of gas. With regard to the two classes of meters, there was no doubt that the dry ones were delicate instruments. They were constructed of different kinds of material; and there was the liability of the diaphragms or skivers (as they were technically called) to get hard and somewhat unworkable, and also the risk of the slide-valves bending. So that, however worthy the dry meter was of their admiration as a piece of mechanism, these things showed that it was a very delicate machine. In the case of the wet meter, the variations which occurred—and they were very small—were simply due to the water-line. Most of the complaints which they had heard with regard to wet meters came from gentlemen who appeared to consult their own convenience; and he would recommend them to advise their Boards to give them more assistance, so that someone else could look after the meters, and leave them free to attend to their duties on the works. The "pitch" of the meter was a very important thing. As a rule it was brought into the house like an enemy, and was frequently looked upon with an eye of abomination by the mistress of the house, and a feeling of alarm on the part of the servant. They found a place for it in a cupboard or a cellar ; and it was really a wonder that a dry meter, fixed in a place like that, registered at all, and that a wet meter did not freeze in the winter. After having made some humourous remarks with regard to giving the cases of meters a more attractive appearance, Mr. Jones said his experience was that in most towns a periodical inspection of meters was imperative, whether they were wet or dry; and, moreover, by doing this, they would be able to detect fraud, which they could not do if they put a meter in a house and left it (say) for ten years without any attention. At Chesterfield, the meters were visited eight times a year; and if he could afford it, he should visit them every month. The larger meters, in fact, were inspected every month, and very large and wet ones each week. He had no predilection in favour of one or the other meter. When a new consumer came to him to have gas laid on, he fixed whichever meter he preferred; but if he left it to him (Mr. Jones), providing the situation was suitable, he gave him a wet one. There was no doubt whatever that the wet meter was the more accurate instrument of the two; but so long as the dry meter was certified by an officer of the Crown to be a correct measurer of gas, and it bore the Government stamp, he took it to be the duty of gas managers to accept it. In concluding his remarks, Mr. Jones mentioned that in his professional capacity, he had taken out all the meters in a town; and he found that impure gas had ruined both wet and dry. Therefore the greater the purity of the gas which they supplied, the greater would be the life of the meters, and the greater the satisfaction of the consumers.

Mr. HEPWORTH said he had listened with a very great deal of interest to Mr. Barratt's references to his past experience with meters; and he could not help thinking, during the time he was reading his paper, that he held a brief for the wet meter. He was one of those who had had experience with both classes of meters. It was once his lot to be in a town of considerable size where nothing but dry meters were used; but now he lived in a town where scarcely anything but wet ones were employed. The leakage of gas in the first case was not more than 5 per cent., and in Carlisle it was now under 3 per cent.; and this they might take as evidence that it was not a matter of choice between wet and dry meters whether the leakage was small or large The meters were all carefully made, and were stamped by a

Government officer; and unless they were correct within the limits of the Act of Parliament, it was impossible that they would be allowed to go into use. He hoped that, whether wet or dry meters were preferred by gas managers, they would, in their own interest and in that of the consumers, speedily arrive at the determination to have them periodically inspected. They did not expect their watches to keep perfect time without attention; and no one could expect a meter, which had to pass through all the vicissitudes which they had heard of during the discussion, to go on for ever without inspection. At Carlisle, he had the meters inspected once in two months, and once a week in the case of large meters. In his opinion, it was also desirable that wet meters should be inspected each week. They had heard from some gentlemen that they put in dry meters instead of wet ones, to save a little time and trouble; but he contended that it was not a question of mere trouble or of expense that should settle this question. One point they ought to keep before them was this, that at whatever cost, time, or trouble, they must attain absolute accuracy, if it was to be obtained. As Mr. Barratt pointed out in his paper, what they wanted to know was that one person did not pay for another person's gas. Absolute accuracy could be obtained, if they were careful in the choice of their meters in the first instance, and if they were afterwards careful to inspect and repair them periodically. As to the position in which meters were placed, if the proprietors of gas-works were themselves gas-fitters, and could undertake in every case to see that these meters were properly fixed, there was not likely to be much fear of the troubles that had been referred to. Where gas companies or corporations did not do fitting work, he held that they should point out the position in a house where the meter should be placed, and should also have some voice as to the kind of fittings that should be attached to it. There was one matter which had not been mentioned, and that was the durability of the wet meter. In addition to the very beautiful mechanism, especially in meters provided with a compensating drum, great durability was obtained in wet meters; but if it were a question of economizing capital expenditure, it would be found in the long run that the outlay would be greater in the case of wet than dry meters.

Mr. Barton confessed that he felt a little reluctance in entering into a discussion upon the subject then before the meeting, because they were dealing with an instrument given them as absolutely correct; and unless they were very careful in what they said, either for or against it, and it came to the knowledge of the consumers, it might make them dissatisfied with both wet and dry meters. In discussing this question, they had three things to consider: First, the capital charge for meters; secondly, their durability; and, thirdly, their correctness as to the measurement of the gas passed through them. Mr. Barratt had not given them any statistics as to the working of the wet meters in Grantham; and he should have liked to know how it worked out per 1000 cubic feet of gas sold, for renewals, repairs, and inspection. He had a few figures with him relating to Peterborough, where dry meters were almost entirely used—in fact, he did not think there were a dozen wet meters in the town. During the past fifteen years, the highest charge per 1000 cubic feet of gas sold, for renewals, repairs, cost of fixing and changing meters, and inspectors' wages was 0·63d. in 1888, and the lowest 0·38d., in 1886—the average of the fifteen years being 0·46d. During that time the unaccounted-for gas had been reduced from 12·14 to 6·45 per cent.

Mr. JONES: Not through the meters.

Mr. BARTON said he did not say so. The consumption of gas fifteen years ago was 38½ million cubic feet; and it was now rather more than 67 millions. Thus the gas consumption had nearly doubled, while the cost of maintaining the meters had been reduced, as well as the unaccounted-for gas. Besides this the price of gas had been reduced from 4s. 6d. and 5s. to 3s. 2d. and 3s. 4d. He thought that dry meters, with proper attention, were thoroughly reliable instruments. In his case they tested at the works one-fifth of the meters every year; so that all of them were tried for accuracy every five years—any meter which was found outside the range being sent to the makers for repair.

The PRESIDENT remarked that, although some mild strictures had been passed on the wisdom of raising a discussion such as this, he did not think Mr. Barratt could have selected a subject which would have produced a more interesting or instructive debate than they had had. One or two points had been made very clear. One was that a low percentage of unaccounted-for gas was not associated merely with the use of one meter or the other. They had testimony from some of the speakers who used dry meters exclusively that the percentage of unaccounted-for gas was very satisfactory; on the other hand, Mr. Hepworth told them that at Carlisle, where he used wet meters, he was in the unique position of being able to report that his leakage did not reach 3 per cent. of the make. At Lincoln, roughly speaking, they had 75 per cent. of wet meters; and their leakage was only a little above 4 per cent. Last year it was 4½ per cent.; and this year he hoped to bring it still lower. His own experience was that wet meters were more reliable than dry ones. What they had to aim at was not the saving of trouble to themselves, but the satisfying of the consumer that he was not charged for more gas than he actually consumed; and to do this they must employ the meter which gave the most satisfactory results. In his district he had about 25 per cent. of dry meters, as against 75 per cent. of wet ones; and his experience with these enabled him to say that a larger percentage of the wet meters might be declared to be correct than in the case of the dry ones. Of the meters that were brought to the works for testing, he was quite safe in saying that for every one wet meter that was found outside the limits of the Sale of Gas Act, they had ten dry meters; and therefore, seeing that the first object to aim at was accuracy, he unhesitatingly said that the wet meter was the most reliable machine. Of course, whether a wet or dry meter should be fixed, was not always determinable by this one consideration. Reference had been made to the position where the meters were disposed. In the majority of cases, builders never dreamed of providing a place for the meter; and then they had to select the most suitable they could find. Defective fittings also caused them a great deal of difficulty. Some gas-fitters thought that dry meters were a positive cure for trouble arising from water in fittings; and it often happened that a request for a dry meter came as a consequence of the annoyance caused by bad work. Of course, in some places where there was extreme liability to frost, it would be better to fix dry meters. The discussion, he thought, pointed clearly to the fact that the wet meter was the most reliable machine; but there might be special cases in which it was advisable to fix dry ones.

Mr. **Barratt**, in reply, said he was exceedingly pleased with the discussion that had been raised by his paper. It was not his intention, when he prepared it, to say all that could be said on the subject; and he was glad that so many gentlemen had taken the opportunity of giving their experience. The question he wished to raise was, as the President had said, which was the more correct measurer of the gas they supplied? It was not intended in the paper to discuss the life or durability of meters; but if the Secretary at any time wanted a paper, he should not object to deal with this point. Mr. Jones said he thought these controversies had ceased. It was the pamphlet which he (Mr. Barratt) had received which suggested the subject; and if these controversies were to cease, then the manufacturers of meters must cease sending round such pamphlets. With regard to what Mr. Manwaring had said, he should like to ask whether the meter he referred to was constructed in accordance with the Sale of Gas Act, and was he right in understanding that the float did not come down until the water was syphoned away—until it came out at the index? Was Mr. Manwaring quite sure the meter was perfect in every way?

Mr. MANWARING said that it passed gas all right. The float had stuck.

Mr. BARRATT (continuing) said as to Mr. Hepworth's observations, he might say that he had no brief for the wet meter manufacturers. It did not make a fraction of difference to him. His only object was to get paid for the gas which his customers burned; and it was their duty as gas managers to see that they had a machine which registered all the gas passed through. If a manufacturer came to him and said he could make a dry meter that was correct, he should be pleased to see it, and would give it a fair test.

On the motion of Mr. WIMHURST, seconded by Mr. JONES, a vote of thanks was passed to Mr. Barratt for his paper.

It was then agreed that the autumn meeting of the Association should be held at Cambridge; and the business concluded. Before separating, however, the members passed a hearty vote of thanks to the Mayor for his kindness in allowing them the use of the Guildhall.

Some of the members spent the remainder of the afternoon in visiting Messrs Robey and Co.'s Iron-Works, to inspect a new 7-horse power gas-engine which that firm had recently completed; while others took the opportunity of going to the Cathedral.

Early in the evening the members and friends dined together at the Great Northern Hotel; the Mayor and the Chairman of the Corporation Gas Committee being present.

SCOTTISH GAS MANAGERS.

ANNUAL MEETING, APRIL 10.

The Eighth Annual Meeting of Scotch Gas Managers—the informal gathering of engineers and managers of gas-works in the western and immediately adjoining counties which was instituted when the West of Scotland Association was merged in the North British Association—was held at the Waverley Commercial Hotel, Glasgow. As in previous years, the meeting was convened by Mr. J. M'Gilchrist, of Dumbarton; and he secured as Chairman on the present occasion Bailie R. Robertson, of the Bathgate Gas-Works, President-Elect of the North British Association of Gas Managers, who was supported by Mr. J. Hepworth, M. Inst. C.E., of Carlisle, President of The Gas Institute, Mr. M'Gilchrist, Mr. A. MacPherson, of Kirkcaldy, and Mr. R. S. Carlow. There was an unusually large attendance.

The business having been opened,

Bailie **Robertson**, on taking the chair, proceeded to deliver a short address. Having expressed his thanks for the honour conferred upon him by placing him in the position he then occupied, he went on to remark that those present would doubtless all look back with pleasure and satisfaction to their former discussions in that place; and he hoped the meeting on this occasion would prove as interesting and profitable as its predecessors had been. They were certainly very much indebted to their worthy and energetic Convener, Mr. M'Gilchrist, for resuscitating the West of Scotland Association of Gas Managers, and carrying it on in its present form; the chief characteristics of that Association being the friendly feeling that existed, and the unrestricted endeavours they made in giving one another the benefit of their experience. It would appear that the want of formality led to more freedom in the interchange of thought and ideas; and he trusted that they would have not a few practical hints thrown out by those present, who were fully charged with long and varied experience in the "ins and outs" of the gas profession. It seemed to him that these "informal" meetings were of more practical value to the managers of small gas-works than the gatherings of the larger Associations, where papers were as a rule of an advanced and technical nature, on account of which many persons were kept back from entering into the discussions; for, although they were theoretically conversant with the most modern appliances that their brethren in larger establishments had opportunities of working, they feared that their remarks would lack the power which accompanied one when talking on a subject of which he had some practical knowledge. In meetings like the present, they had no special programme drawn up; and their remarks were not confined to any particular topic. They might speak of any branch of their work, of any of the difficulties they had met with during the past winter, and how they had overcome them. They might tell of the difficulties they still encountered, so that suggestions might be given as to how they could be removed; and should any of them have adopted new modes of working that had proved satisfactory, they were invited to make them known, so that all might reap benefit therefrom. Any winter's work of a gas manager was fraught with considerable anxiety; but he believed the winter that had just passed had brought with it more care and anxiety than had ever previously been experienced by any of them. The labour troubles, the high price of coal, and the railway strike had affected them all round; while here and there the harassing burden had been increased on individual managers by serious accidents—those which came home to most of them being the disasters at the Middlesbrough and Dawsholm Gas-Works and the Govan Iron-Works. The one at Middlesbrough affected them because the Manager there—Mr. David Terrace—was so long associated with their meetings in Scotland; and the others, because they happened so near their own doors. The explosion at the iron-works was the most serious of all, on account of the loss of life by which it was accompanied. They all remembered the kindness shown to them, on the occasion of their last meeting, by Mr. Millen, the Manager, in conducting them round the works under his charge; and the news that he was one of the victims of the explosion would, he had no doubt, give rise to feelings of the deepest regret in the mind of every one of them who experienced his kindness last April. These events would tend to make the winter of 1890-91 ever memorable.

Proceeding from these matters, the Chairman remarked that it would be interesting to have the experiences of managers during the last few months narrated, particularly those obtained during the railway strike—how each contrived to keep up or eke out his coal supply. With regard to the labour troubles, Scotch managers had not been so directly affected by them as some of their brethren in the South, although in some places pressure was brought to bear on gas workmen, by outside agencies, to combine in a general strike with the railway men. Fortunately, the efforts in this direction were unsuccessful. He thought there was less cause for the paid agitator to stir up strife between masters and men in the gas industry than in others he knew of; for, as a rule, the relationship between manager and men was of a pleasant kind. The former looked upon the works as his home, and the workmen as his family; and he was always ready to remedy any grievance that might occur. So long as they could retain this relationship, taking an interest in the men under their charge, he was certain that the proposed Boards of Conciliation would have no work from them. What they had to fear most were those labour troubles that occurred outside gas-works which affected their industry, more especially that of the miners who secured their coal, and the railway men who conveyed it to their works. But there was not much to fear even from these sources in the immediate future—certainly not from the railway men, now that their cause had been lost; and with regard to the miners, should the Eight-Hours Bill become law, it would make but little difference in Scotland, for they had had this practically for two years. The majority of the miners in Scotland during this time had worked rather within than beyond the eight hours per day; and they likewise took off an additional full day every week. The result of this restricted labour had added considerably to the advance in the price of coal; and now that the blast-furnacemen had resumed operations, and the demand for coal had still further increased, they might look for another rise. The increasing cost of cannel was of momentous importance to gas managers, who were brought face to face with the alternative of either lowering the illuminating power of their gas by the use of poorer coal, or finding some mode of enriching the gas obtained from that poorer kind of coal—some mode that would give gas of as great permanency and high illuminating power as they now obtain from cannels, and at less expense.

The Chairman next thought it desirable, in the few remarks he had still to make, to direct the attention of managers of small works to the benefits to be derived from the erection of scrubbers and exhausters. He was anxious to do this because he had himself experienced their benefits, and had noticed that a large number of the smaller works were still without these important appliances. Doubtless this was because the profits to be derived from their use had never been sufficiently placed before them, or had never been thoroughly understood. He wished to point out that the erection of scrubbers and exhausters was not useless expenditure for small works, but really a source of income. Some nine years ago there had been erected one of Young's washer-scrubbers at the Bathgate works; and the expense of its erection was very nearly covered in one year's working. Including the connections, the total cost amounted to £65. In the year's working there was an extra yield of 10,000 gallons of ammoniacal liquor, together with a great saving of lime; and the purifying account was thus brought down to rather less than ½d. per 1000 cubic feet of gas. The 10,000 gallons of liquor, at 10s. per 100 gallons, amounted to £50; and the saving of 4 tons of lime, at 10s. per ton came to £2—thus making a total revenue, for one year's working, of £52, or not much short of the total cost. The price of liquor was not so high now as it was then; but it was still high enough to warrant any gas company in proceeding with the erection of such a scrubber. He considered it to be unnecessary for him to explain the construction of the appliance in question, as this had been done by the patentee, and by the late Mr. Scott, of Falkirk, at the North British Association meetings; and the description could be found in the records of the Association. With regard to exhausters, he believed that his works at Bathgate were the smallest in Scotland that had one; but notwithstanding their limited capacity, the exhauster, working for six months of the year, showed a gain of 15 per cent. on the cost of its erection. The total cost of the exhauster, engine, boiler, and connections was £230; and the extra quantity of gas drawn off, amounting to something like 500 cubic feet per ton of coal carbonized, produced a yearly profit of from £34 to £35, besides the saving of retorts through the reduction of carbon deposit. The gain was not so great as that obtained from the scrubber; but it was sufficient, he thought, for the serious consideration of all gas-works managers. The make of gas exceeded 5½ or 6 million cubic feet per annum.

In drawing his remarks to a close, the Chairman said that he did not wish to trespass longer on the time of the meeting; his object having been merely to make a short introductory speech by way of opening the proceedings.

A discussion then took place on the various topics suggested by the Chairman.

Mr. Hepworth, referring to the Chairman's remarks regarding the troubles of the past season, said he felt with him that they were almost unique. He (Mr. Hepworth), although not actually living in Scotland, had also had his own difficulties over the Border; for he was, during the Scotch railway strike in the depth of the winter, within 24 hours of being absolutely without cannel such as would enable him to produce gas of 20 candles. As he was not able to get it from Scotland, he obtained it from the South. He had a railway siding into his works; and he had a locomotive which he lent to a neighbour. By so doing he obtained a supply of coal to meet his immediate requirements; but in the eyes of the railway men at Carlisle he became a "blackleg." He hoped, however, that he might be forgiven. As to the prospective high price of cannel, of which the Chairman had spoken, the news might be comforting to the coal proprietors, but it was by no means cheering to him as a gas manager; and he hoped the Chairman might prove to be wrong in his prophecy. But if the price of cannel were to rise much higher, he was satisfied that they would be obliged to resort to one or other of the alternatives suggested in the address—neither of which courses, however, did he think was desirable. There was, it was true, a third alternative, which was to raise the price of gas; but, in view of other cheap lighting agents, he did not think it was well to have recourse to such a remedy. Referring to the question as to the relations between employers and employed, he said he was glad to hear from the Chairman that there was no need existing in gas-works for Conciliation Boards. His own opinion, however, was that the friendly feeling which formerly existed in their works, had been somewhat disturbed of late; and he feared that gas managers might find that their workmen were not wholly outside the influence of the paid agitators—men whose business it was to stir up strife. Mr. Hepworth cordially supported the views of the Chairman in respect of the equipment of small gas-works. Scotland had always been ahead of England in regard to the erection of scrubbers and exhausters; but still it was a marvel to him that they had not been more largely introduced into the small gas-works. He quite concurred in the remark in the address as to having such appliances in works where the annual make of gas was as low as 5 million cubic feet; and he would even include works having a make of only 3 million feet. Alluding to an instance within his own experience, he remarked that some eighteen or twenty years ago he had had something to do with a small gas-works in Scotland, and he had been the means of introducing a washer and a scrubber, both of which, however, had fallen out of use. It was absurd to think of small works not using such appliances. He went on to refer to the case of small gas-works that were far away from tar-distilling establishments disposing of their tar and liquor to advantage, and suggested that such works might be established for certain districts of the country on the co-operative system.

Mr. J. M'Crae, of Dundee, said gas managers had got through the difficulties of the winter, which had not by any means been small. There had been the strike difficulties; and those of the speaker had been equal to Mr. Hepworth's. He was glad to be able to say the coalmasters had stood by the gas managers, and kept them out of danger. But the prospects were not bright in respect of the price of coal, the rise of which must come to an end. A huge mistake was being made in regard to rich Scotch cannels. He could not see why such coal should be sent abroad and not be available for use in gas-works at home—indeed, in this matter he considered that there was something radically wrong which ought to be rectified, or else they would have to resort to the use of oil for the manufacture of gas, reduce the quality of the gas, or make a higher charge for it. Speaking of the equipment of small gas-works, he said that in his opinion, there was no good reason why every modern appliance should not be obtained for a small as for a large works—for one supplying a population of 15,000, as for one furnishing gas to a town of 150,000 persons. The same principle should be adopted in both kinds of works in regard to scrubbers, exhausters, &c. Referring to the papers submitted to the meetings of Gas Managers' Associations, he urged that those managers who were supposed to be outside the "inner circle" should make it a point of duty to prepare papers embodying the experience gained in their respective works, so as to secure that all questions of difficulty might be ventilated in the company of other managers on whom they might rely for obtaining advice.

Mr. H. Aitken (Falkirk), speaking as a coalmaster, and referring to the "third alternative" which had been spoken of, said that they would have to face the difficulty as to the increase in the price of cannel. The coalmasters had for the last ten or fifteen years been working at a loss, or without profits, while proprietors of gas-works had been getting good profits. They must now do with less profit. He (Mr. Aitken) put the position of affairs plainly and bluntly. The cannel was wanted by the foreigner, who was willing to pay the price asked; and whoever was prepared to pay the biggest price would certainly get it.

Mr. R. **Mitchell** (Edinburgh), in dealing with the question of the quality and price of gas, said that the general public had the matter in their own hands. He referred to his recent experience in Edinburgh, stating that he had been instructed to produce 27-candle gas; and, as a matter of course, the consumers must pay the necessary price for it. Then, as to scrubbers, exhausters, &c., he had no hesitation in saying that every available improvement should be introduced into small gas-works as well as into large ones.

Mr. D. **Robertson** (Dunoon) held that there was as much ability needed in managing a works supplying a population of 15,000 as one providing gas for 150,000; and he referred to his experience in the works under his charge. He had been much benefited by having a scrubber; and he had been able to prevail upon his Directors to go the length of getting an exhauster. It had enabled him to produce 800 to 900 cubic feet of gas per ton more than formerly, and this was equal to a return of about 20 per cent. upon the ontlay. Unlike the Chairman, he was able to use his exhauster nine months in the year; and he would not now care to be without it.

Mr. D. **Vass** (Portobello) briefly alluded to the difficulty of dealing with the tar made during the railway strike; and on the question of obtaining coal during that period, he said he had been able to get his supplies direct from the pits by carting it.

Mr. A. **MacPherson** (Kirkcaldy) was of opinion that the topics for discussion indicated in the Chairman's address had been well thrashed out. He would himself, however, bear out what had been said regarding the propriety of equipping small gas-works with such appliances as had been mentioned. He had himself put them into small works; and they had yielded exceedingly good returns. In his opinion, even more ingenuity was frequently displayed by the managers and engineers of that class of works than by those having charge of large ones; and the greater the efficiency of the management, and of the appliances in use, the greater was the profit. As they accomplished their returns frequently on very limited means, the managers of small works deserved to be highly commended for them. As to the railway strike, he stated that he had not been ill-off during its continuance. Fearing that it might be of some duration, he began to "yell" at the beginning of it; and he succeeded in getting a sufficient supply of coal. The coalmasters were worthy of much commendation for the strenuous efforts they put forth to meet the difficulties with which gas managers were confronted; and this might also be said of the railway companies.

Mr. Gavin Paul (Edinburgh), dealing with the coal question, said he was not ready to agree with those speakers who desired that the price of cannel should fall. His opinion was that the value of cannel, as of any other commodity, was what it would bring. He also remarked that gas managers had encountered and overcome much more serious troubles than the high price of cannel; and they would also overcome that difficulty.

Mr. M'Gilchrist (Dumbarton), like Mr. MacPherson, thought that the other subjects for discussion had been sufficiently well thrashed out; and he suggested that the Dawsholm explosion* might be spoken of, as it would be highly interesting to gas managers to know how and from what cause it took place. His opinion was that dynamite had nothing whatever to do with it. There was a great desire on the part of practical gas managers to learn what the real cause was; indeed, he believed that the cause was well known. Another matter that he would refer to was the desirability of having abundant room for storing coals. All gas-works were short on this score; while in some cases managers had to be content with a week's, or, at most, a month's stock of coal. Storeage for two or even three months' supply was really needed. All managers ought to have ample storeage, so as to be able to get in supplies of coal during the summer or autumn. By doing so, they would help the railway companies to provide against such difficulties as arose during the strike.

Mr. J. M'Crae alluded to the question of Trades Unions, and said he was not disposed to denounce them. He was of opinion that, if the men whom they employed had any grievances, it was the business of the employers rather to anticipate the men's demands than wait till they were forced to consider them by the action of the men. There had been great difficulty with gas stokers; but he would like to have the moral tone of the men, and their relations with their employers, raised. He held that a day of eight hours was long enough for stokers to be employed, considering the severity of their labour, and the circumstances to which they were exposed, even though their work was not continuous during the whole of the shift. A Sunday shift of eighteen hours was far too long; his men in Dundee were never on duty more than twelve hours on Sunday. Mr. M'Crae mentioned what had been done for the comfort of the men under his charge; and urged that even though it cost

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* The explosion here referred to (supposed to have been caused by dynamite) occurred on the afternoon of Jan. 15, 1891, and resulted in the destruction of two large gasholders. Particulars of the disaster will be found in the *Journal of Gas Lighting*, Vol. LVII., pp. 116, 163, 196.

1d. per 1000 feet on the price of gas to make the men comfortable as to warm baths, &c., it should not be grudged. Employers should be the first to endeavour to bridge over the difficulties which were liable to arise with their workmen.

Mr. R. S. Carlow (Arbroath) mentioned some of his experiences as to gas-works' appliances both at Port-Glasgow and at Arbroath. He also gave an interesting account of the way in which he had managed to have his coal supply maintained during the strike. Of course, he had to content himself with inferior coal, which had yielded less gas and of lower illuminating power than was customary; and consequently he had had to employ more labour to deal with the extra quantity of coal used. His men had eight-hour shifts; and they were pleased with them.

After some remarks by other speakers,

Mr. M'Gilchrist referred to the Bo'ness explosion (of November, 1889), and what he considered was a wrong decision given by the Court of Session regarding the legal action to which it gave rise.* He urged that gas companies and corporations should take the matter up, and carry the case to the House of Lords.

Several of those present spoke on this subject; but no definite result followed the discussion.

A vote of thanks was passed to the Chairman for his address; and, on the motion of Mr. M'Gilchrist, it was agreed to ask Mr. T. D. Hall, of Montrose, to preside at next year's gathering. The thanks of the meeting were also awarded to Mr. M'Gilchrist for his services as Convener.

A dinner subsequently took place, Mr. Robertson presiding.

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* This case was reported in the *Journal of Gas Lighting*, Vol. LVI., p. 93.

NORTH OF ENGLAND ASSOCIATION.

HALF-YEARLY MEETING, APRIL 25.

This Meeting was held in the Offices of the Newcastle and Gateshead Gas Company—Mr. W. Hardie, jun., Engineer and Manager of the Tynemouth Gas Company (the President), in the chair.

New Members and Associates.

The following gentlemen were admitted to the Association: *Members*—Mr. P. H. Wilkinson, Manager of the Harrogate Gas-Works; Mr. C. Bainford Williamson, Assistant-Manager of the West Hartlepool Gas-Works. *Associates*—Robert Wallis, Esq., J.P., Chairman of the South Shields Gas Company; Mr. T. Havelock, of the Wear Fuel Works.

The President's Opening Remarks.

The President said that, before going on with the business, he should like to mention that, at their last meeting, he took the opportunity of referring to the illness of their Vice-President, Mr. J. H. Cox, jun., of Sunderland. He was very pleased to hear that Mr. Cox was now somewhat better than at that time. He had, however, not returned to England; but they all hoped that he would soon come back restored to health and strength. Under these circumstances, the Committee had thought it advisable that Mr. Cox should be retained in the position of Vice-President for the coming year. They also suggested that the Association should appoint Mr. Wallis as their President. Considering the long time Mr. Wallis had been very closely connected with the gas industry in the North of England, and in view of the interest he had shown in all subjects that had a tendency to increase the prosperity of gas companies, he (the President) thought the Association would act wisely if they elected him. As was known to a number of them, Mr. Wallis had had a great deal to do in bringing forward things to the advantage of gas undertakings. Many years ago, when the manufacture of sulphate of ammonia was almost unknown among gas makers, Mr. Wallis introduced plant for this purpose at the South Shields Gas-Works; and a few years ago he inaugurated the exhibitions of gas appliances which had become so popular. They would all notice with much satisfaction that a Royal Commission had been appointed upon the labour question. There was no doubt that there was much to be cleared up on this highly important subject; and he thought it very likely that much good would result from the deliberations of the Commission. He was pleased also to notice that Mr. George Livesey, Chairman of the South Metropolitan Gas Company—a gentleman who had always taken a great interest in working men, who had some idea at any rate of the operations of Trades Unions, and who had also had considerable success in dealing with his own workmen—had been appointed a member of the Commission. He (the President) had no doubt that his services there would be very valuable. The gas industry seemed to be still in a very prosperous condition. He noticed that with most of the local undertakings the increase in consumption was as much as it had been in the past, when they had fewer rivals.

Mr. David Terrace (Middlesbrough) then read the following paper:—

DISTRICT PRESSURE.

Although the science of the distribution of coal gas is now well understood, I apprehend that in a great many instances its principles are not carried out in their entirety. One of the reasons that may be adduced for this may be that the street mains, which are practically adequate nearly all the year through (excepting, perhaps, for two or three months in mid-winter), are made to do their work at the time of greatest demand by increasing the initial pressure. This may be considered sufficient for the time being; but when winter after winter passes, and more and more pressure has to be put on to meet the extra demands, I think it will be conceded that, at best, it is a clumsy, and often a very inefficient way of getting over the difficulty.

The premises are that gas must be used at a certain known pressure; therefore a continuous equal pressure should be maintained at the outlet of every consumer's meter, let such consumer be near or distant from the gas-works or other source of supply. In other words, we are entitled to give each his due within certain limits—say, between 10-10ths and 12-10ths of an inch pressure, which should be ample for all purposes of lighting, cooking, heating, and motive power. Indeed, 7-10ths would meet each of these cases, if the house fittings were of sufficient size for their work. It may be urged that it is scarcely possible to give such an equal pressure at all times, and that consumers within the range of high pressure (which may at times be from 20-10ths to 30-10ths) should guard themselves against it by using governors, &c. But as we have the means in our power of equalizing pressure throughout the town and district, these should be carefully adapted to furnish an ample gas supply, at a comparatively low pressure, to every consumer. This is all the more necessary as it is well known that the great majority of our customers do not trouble themselves as to how gas should be used to arrive at satisfactory results in lighting, cooking, &c., either for efficiency or economy's sake.

The circumstances under which gas is distributed are sometimes very complicated; and this leads to each case requiring a somewhat different mode of treatment. I may here mention a few of the systems of gas supply in vogue: (1) Small towns, where the works have a station governor, with trunk mains in the principal streets—the mains generally diminishing in size towards their extremities; branch mains in side streets, also diminished; the cross streets supplied through mains connecting the side streets. (2) Large towns where the works have two or more station governors supplying mains leading in different directions of consumption. (3) Larger towns, with suburbs into which the trunk mains have been extended, and possibly portions of the mains nearest the works taken up and relaid by larger ones; consequently the remarks as to diminishing in size apply in a still greater degree. (4) Compactly-built cities with suburbs, which generally have two or more large gas works stations for supplying from different points, and when under one company or corporation, have the trunk mains, &c., connected. (5) Cities or large towns, parts of the area of which are on hilly districts. These, in addition to having gas stations, may have district holders on different levels of supply; or the elevated districts may be zoned—*i.e.*, separate portions at certain altitudes supplied by a main to each (the pressure being controlled by district or differential governors), or by means of a main direct from the works, and the pressure governed therefrom. (6) Great cities, where the works are at such a distance as to occasion the use of exhausters to draw the gas from the outlet main, and deliver it through street mains to the consumers—a holder or holders intervening, which serve to contain the night stock, and also to ensure steadiness of pressure. (7) Combinations of the several foregoing methods or systems.

I have taken special notice of the general practice of diminishing the area of mains as the distance from the works increases. I think the trunk mains at least should be kept to their full bore throughout their entire length, for the reasons that the farther the gas travels the more is the pressure lessened, on account of the gas being drawn from the mains, and the friction is proportionally very much greater in small than in large mains. This points to the idea that, instead of decreasing, mains should be increased in size the farther they are from the source of supply. In the latter case, the pressure is likely to be more equable than in the former. The same remarks should, of course, apply to fittings in houses and other premises where gas is employed.

I was very much interested when reading, in the *Journal of Gas Lighting* for Sept. 2 last year, the account of the manner in which pressures are controlled in the district of The Gaslight and Coke Company of London. It is briefly this: A series of high-pressure mains interlace, so to speak, the ordinary street mains; joining them at certain points where a governor regulates from the high to the desired district pressure. A telephonic system places the whole in communication, so that a deficiency at any point is at once supplemented, and a surplus checked. It appears to me that this is the best and most efficient means of obtaining an equalization of pressure over towns and districts. The system, or a modification of it, would be applicable under almost any conditions of gas supply; and it would prove a preferable mode to enlarging portions of the trunk and branch mains, as the effect of doing this is sometimes of only problematical benefit, unless the whole system is revised on the lines indicated. That is to say, although greater carrying capacity may be given to certain streets or districts, the full effect intended may, and very likely does, fall far short of what would be expected.

Now that pressure registers are made portable, and to act without the slightest friction, they give a very exact and permanent record. They should be employed at regular intervals, especially during the times of greatest consumption, to ascertain the street pressures. I have here a diagram representing the pressures as simultaneously recorded at the gas-works, town, and district respectively. Several other diagrams were taken during the past winter at various parts of the district; but I have reproduced what may be termed the worst case in respect of district pressure. During the time of least consumption, the pressure lines keep nearly parallel; the difference being merely due to altitude, &c., whereas at the time of greatest consumption, the lines show the greatest divergence. The "Town" line shows the pressure at a point about 1000 yards from the works, and was taken from a 16-inch main, which is supplied first through a 24-inch main on the 18-inch, and then to the 16-inch. The "District" line shows the pressure on a 3-inch main situated about 3000 yards from the works. It should be stated that the average hourly consumption during lighting hours was about 150,000 cubic feet. It may be explained that the situation of the works is in a thickly-populated industrial area of about a square mile, which is termed the old part of the town. Just outside this, on one side of it, is the new part, into which the mains have been extended. It is from the 16-inch main in the centre of the new part of the town, that the "Town" pressure diagram is taken. The original mains have been supplanted by the larger ones referred to, which in their turn should either be enlarged or the system advocated adopted—*i.e.*, an independent high-pressure main or mains from the works direct to the new town and district.

The obligations of gas companies and corporations are becoming more onerous as regards a full and efficient gas supply during the whole of the 24 hours. Times were "easy," comparatively speaking, a few years ago, when lighting was nearly the only purpose for which gas was required. What we were inclined to grumble at then was the unproductive capital employed; and we wished for the time when the mains would be in use during the daylight hours. Now we have attained our desires—at least to a considerable extent; and we find that this brings duties along with it. In towns which are free from fogs, the demand is nearly constant; but when King Fog appears, then is the strain, and this has been very marked in several large towns during the past winter. Gas was wanted for lighting during the day; and to keep the ordinary "cooking" and "power" pressure on, would have resulted in draining supplies reserved for evening hours. Hence, complaints were loud. We like the steady pull from the mains during the day, and every day; but when a few days' fogs appear—and they generally come when least expected—it is scarcely possible, with the present means at command, to cope successfully with them. Having the making power and holder room are ways of alleviating the difficulty; but even these prove futile during prolonged fogs, or dull, or very cold weather. Having the power to regulate the pressure to a nicety over the whole area of supply would prove another means whereby we could easily do more justice to our consumers. In some towns, this is done; but much requires to be accomplished before it can be said that it is as universal as it should be.

Discussion.

The PRESIDENT said he hoped they would have some interchange of ideas on this very important subject.

Mr. J. HALL (West Pelton) said he had taken a great deal of interest in the important subject before them. A remark was made in the paper as to the pressure at the commencement of the delivery of the gas. If anyone looked up the reports of the West of Scotland Association, upwards of twenty years ago, he would see that in the town of Ayr he read a paper, on the pressure and distribution of gas, similar to the present one. In many cases they would find that the large pipes were at the wrong end of the system. In his paper he showed that it was at the place of delivery that their difficulty took place. Another point in distribution was as to the junctions. In connection with this, he found that by making them about double the usual size, and bell-mouthed, the inrush of gas was steady. His general experience was that there was a misapprehension as to main pipes, because where they should be largest they were usually smallest.

Mr. W. J. WARNER (South Shields) thought that, as an Association, they were indebted to Mr. Terrace, as they would be to any gentleman who would bring the subject of pressure again and again before such Associations as theirs. He considered it good to go through the whole of a district, month by month, to ascertain the pressures, both high and low. This gave them an indication of the distribution. He believed they ought to have a town districted—dividing the higher from the lower portions. In his district, some years ago, they separated the manufacturing from the suburban or residential portion of the town. They required a pressure (say) at six o'clock in the morning on the river side, which was not wanted in the outlying districts. It would be found that (say) at Gosforth they did not need a pressure of 1 to 3 inches at that hour in the morning; but on the river side it was different. With reference to the equalization of pressure, he differed from Mr. Terrace. He thought they could scarcely have the whole of a district or town at fixed pressures throughout the entire 24 hours, even though their plant might be capable of delivering it, and the district round were suitable. He did not believe this would be satisfactory to the consumers. Speaking of very large works, he might say he was disappointed with the paper—not with the way in which Mr. Terrace had handled the subject, but because he thought they should have had some statistics.

Mr. J. HEPWORTH (Carlisle) agreed that probably not many members of the Association themselves knew what took place from time to time in the several parts of their supply outside their works. But there, before them, was a diagram which very distinctly showed them the pressure in the various parts of the town and in the outlying districts. If any argument were needed, the diagram contained it, by showing that a series of high-pressure mains, interlacing the supply, should be brought into use for the purpose of equalizing the pressure over the whole area of supply. If the diagram did not prove that, at all events it proved what a person in a small town would probably admit—that larger mains were requisite in order to equalize the pressure of gas over the whole area of supply. The subject of pressures was a very much wider one than the paper represented; and he felt that there were gentlemen in the room who had had experiences they could relate which would be very valuable. For instance, everybody did not live in such a flat district of supply as probably Mr. Terrace did at Middlesbrough. He himself came from a town where he had scarcely any difference at all in the levels; but he knew very well that in other places the levels were so interrupted that it was a matter of extreme difficulty to equalize pressure over a town of even smaller size than Carlisle. One point mentioned by Mr. Terrace was the greater necessity that now existed for giving an equal pressure during the varying requirements of the 24 hours. What they could do for the night consumption, they certainly could do for the day; and if the consumers' requirements were less in the daytime than in the evening, there could be no difficulty in arranging the supply over the whole 24 hours. The great thing was to endeavour to ascertain, as Mr. Terrace had done, what the pressures were. He thought the paper was a very valuable one.

Mr. V. WYATT (London) said there were one or two remarks in the paper which were perfectly correct, and which he found to be correct 23 years ago. At that time a great deal of discussion took place as to whether they should increase the size of the mains at the point farthest from the works; and the conclusion come to was that this ought to be done—that as the friction became greater, so should the area of the main be enlarged to compensate for it. They did not make their pipes larger; but they compensated for it in this way: They put on an enormous pressure, of from 18 to 24 inches; and so they could send any quantity of gas through a 4-feet main to the distributing-pipes at the other end of the district. They used to have a leakage of 17 per cent., and now they had only 5 per cent.

Mr. H. **Lees** (Hexham) would have liked Mr. Terrace to have said something about the leakage account. He had found many cases in which the consumer had had an ample supply of gas at the meter, but did not get sufficient at the burner.

Mr. M. **Richley** (Shotley Bridge) narrated his experience in supplying gas to collieries, and asked how the pressure in such a case could be regulated.

Mr. **Hall**, in explanation of this, said a good deal depended upon the regulation of the steam-pipe. If the steam-jets were working right, every collier had his own proportion.

The **President** said he had listened with great pleasure and interest to the paper, which dealt with a subject he had at times found exceedingly difficult. When he looked over Mr. Terrace's diagram, he thought that really Middlesbrough must be a most blessed place to be in, for this reason—that the pressure all through could be maintained at a very low figure. In most towns a pressure of 15-10ths was required to give satisfaction; but he found that Mr. Terrace could satisfy people for a considerable part of the 24 hours with a pressure as low as 10-10ths, which must keep his leakage account very low. Besides this, he noticed that Mr. Terrace had, in outlying districts, the pressure at some periods of the day as low as 9-10ths. He should consider this would cause very great discontent, because Mr. Terrace had just told them that 12-10ths was the thing they might expect the consumer to be satisfied with; and therefore if the diagram before them were for a series of nights, he really did not know how Mr. Terrace managed it. In the case of having a gas-works at the highest part of the town instead of at the lowest, what seemed to be necessary was to take a leading main from the most elevated down to the lowest point, and then to allow the gas to rise again. In that case there must be a heavy pressure through the leading main; but as there was no consumption off it, the leakage was not high.

Mr. **Terrace**, in replying, said he was somewhat surprised to find Mr. Hall's and Mr. Wyatt's experience agree with his own, in so far as they knew about this matter some twenty years since. It was rather a slur upon gas managers that, if these facts were before them so long ago, the larger mains should still be nearest the works. The facts could not have been satisfactory, otherwise gas managers would not have gone in the opposite direction. He did not think there was much in enlarged junctions, provided they had a junction which was of full size. It would possibly be an advantage; but it was a question whether it would be worth while. It was said that they should have pressure to suit the demands of different districts. What he said they should do was to set their house in order, and give a better supply at a lower initial pressure. He was surprised, when he went to Middlesbrough, to learn that they could do with so little pressure; for 12-10ths during the day-time was abundant. He had no complaints whatever of the pressure at night, except in the district shown on the diagram. It was certainly a fault; and this was the reason for his ventilating his experience before the members. In the district which had a very low pressure at night, if they put on pressure at the works it did not reach the point of supply. Suppose they put on 25-10ths at the works, it would be only 10-10ths in the district. Up to this time the leakage in Middlesbrough had been about 10 per cent.; this year he should be able to bring it down to 7 per cent. This was not being done by reducing the pressure, but by rectifying something that was wrong inside the gas-works. This circumstance showed how careful they should be in looking into everything connected with their works. He thanked them for the kindly reception they had given to his paper.

Mr. Wyatt, in explanation of the point that additional pressure did not mean greater leakage, said that in the 4-feet mains in London, whatever the pressure might be, there was no increase of leakage; the mains were simply big gasholders.

The President then read the following paper prepared by his father, Mr. William Hardie:—

SHOULD OWNERS OF GAS-WORKS BECOME TAR AND AMMONIACAL LIQUOR DISTILLERS?

The question which I have suggested for your consideration is an important one for companies and corporations who are owners of gas-works. It was incidentally alluded to at our last meeting by the President, as well as by Mr. Bower; and it has also been discussed at other Association meetings. The Legislature evidently seems to have been under the impression that owners of gas-works might work up their tar and liquor; as, in recent Acts of Parliament, clauses have been inserted giving these bodies power to utilize residual products—such powers, however, not to prevent them from being liable to indictment for nuisance to which they might be liable in consequence of such operation. Very few companies have availed themselves of this power, so far as the distillation of tar is concerned. Out of 80 of the largest companies in England, there are not more than seven who are tar distillers; and those, for the most part, only carry the distillation to the recovery of the primary products. The Gaslight and Coke Company (London), I believe, are different, as they manufacture with the tar several distinct specialities—such as benzol, anthracene, and other articles. Why have so few gas-works a tar distillery? One reason is that, in many cases, the works are situated in the centre of large towns, and the addition of a tar manufactory might be considered a public nuisance. I know that in Newcastle, many years ago, the Company distilled their tar; but, while it lasted, they were continually being found fault with for causing the emission of bad smells and other noxious effluvia. Although committees of scientists were engaged to investigate the matter, they never arrived at a really satisfactory solution. By no process of reasoning could they trace the alleged smells to the tar-works. Still, the agitation continued; and in order to allay it, the works were discontinued, and the tar sold to a contractor. In addition to the nuisance that is supposed by some people to arise from tar-works, there is also the apprehension of danger; and under this head we have certainly had some terrible experiences in this neighbourhood by two very destructive fires, accompanied not only by loss of property, but also by the sacrifice of valuable lives. However, I think that, with increased experience which has been gained as to the management of such works, there is no doubt of their being carried on with practical safety. Still, the fact remains that, with the facilities possessed for establishing tar-works, companies and corporations are not generally disposed to take advantage of them; and so I think we may conclude it is desirable to leave them alone.

Under these circumstances, the question arises as to the means of making the best of the other alternative—viz., the selling of the tar. Here, to my mind, comes in the propriety of a sliding scale, so that the benefit of the market value may be secured. Of course, a sliding scale may not be of service when the tar is sold only for one year, or even for two years; a fixed price may then be resorted to. But where a contract is to last three, or five, or seven years, a sliding scale will be found the fairest both for seller and buyer. On what principle, then, would you base your sliding scale? In one place, I find that the tar is sold at a price which is fixed by a mutually chosen arbitrator. In other places, it is decided by the profits made on the article by some large distiller; and as The Gaslight and Coke Company are, perhaps, the largest tar distillers in the world who publish their accounts, advantage is taken of these to find the price. A clause is inserted in the agreement with the contractor which stipulates that the price to be paid by him (say) for a half year shall be at the rate of so much per cent. of the price realized by The Gaslight and Coke Company during the same period for all the tar distilled at the gas-works at Beckton, or sold by them. The accounts of the company are made up every half year; and whatever difference there may be between the price charged to the contractor for the previous six months and that realized by the Company for the same period, is then adjusted. This system has been in use by several companies in this neighbourhood for some years, and has given satisfaction to both sides. I commend it to your consideration.

But while gas manufacturers keep aloof from the distillation of tar, it is altogether different with the production of ammoniacal liquor. Although, as I have said, only seven of the largest gas-works distil their tar, nearly 50 out of the same number manufacture sulphate of ammonia. This is not only the case with the large works, but also with a very great number of small ones. It may be assumed, then, that it is desirable for owners of gas undertakings to make sulphate. This being so, those who enter upon the business should endeavour to ascertain the most profitable means of carrying it on. Under this head, it is surprising what marked differences there are in the results obtained. I find that the quantity of sulphate made per ton of coals carbonized varies enormously. In some places it is as low as 17 lbs.; in others, as high as 32 lbs. Of course, one reason of the difference is the kind of coal used. The best results are obtained from Wigan and Yorkshire coal. The users of these coals get, on an average, about 26 lbs. per ton. On the other hand, where Durham coal exclusively is employed, the results vary from 17 to 26 lbs.—the average being 19½ lbs.

While it would seem right, then, for gas-works to have associated with them sulphate of ammonia works, there is much to learn as to the proper *modus operandi* for producing it. There may, indeed, be local circumstances influencing greatly individual cases; but the subject is one that is worthy of the most careful attention. Those who are not doing so well in this department might consult, to their advantage, those who are doing better. The highest score reached by Durham coal, so far as I know, is that obtained by our neighbour West Hartlepool, where they get 26 lbs. of sulphate per ton of coal carbonized. A few pounds more sulphate per ton of coal means, in the cases of small works, hundreds of pounds, and in the case of larger ones thousands of pounds, more income per annum.

From the facts, then, which I have brought before you, I think it appears that it is advisable for owners of gas-works to go in thoroughly for the distillation of ammoniacal liquor, while they may allow the tar to go to the best bidder; always provided, however, that the competition for the article is a fair one, and that there is no combination among buyers to keep the price down, in which case I should certainly say, "Start works of your own." My remarks are short; but if they are of any service to you in the elucidation of the important question I have dealt with, I shall be glad.

Discussion.

Mr. V. WYATT stated that some ten or twelve years ago, when they were finishing the works at Beckton, he came down to Newcastle and proposed to the late Chairman of the Newcastle and Gateshead Gas Company a scheme for a great district factory for the treatment of gas products, to which all the products of gas-works within 100 miles might be sent. By means of such a factory, they could regulate prices and get rid of the middleman. He obtained the idea from the central butter and cheese factories in the United States, to which the farmers forwarded their milk, and had a return equal to the quantity they sent. His opinion was that they could creosote sleepers, make tar pavements, and get all the other derivatives from tar; and that they would keep the profits to themselves—being able, he believed, to clear 50 per cent. The scheme, however, was not proceeded with. But, as the members knew, it had been carried out at Beckton, exclusively for the benefit of one Company; and it might also be carried out at Newcastle. They could have their own railway stock, and a communication from the railway to the works. He knew one Railway Company who creosoted their own sleepers; and members would be astonished to know the profit they made upon it. In the United States tar was becoming so valuable that it paid to send it 1200 miles. It would become still more valuable; and it should be the object of gas companies to get these things within their own grip, rather than let the outside public take cash out of their pockets.

Mr. W. J. **Warner** thought it was due to the gas managers and engineers situated on the banks of the Tyne to say that the idea which Mr. Wyatt had propounded was not an original one. He remembered, many years ago, talking of it with Mr. Hardie. It was patent to them that there were tar distilleries in the district which were common to them all; and that, by a combination, they could work up their residual products, to the advantage of the companies in the district. He believed there was one obstacle which would prevent such a proposal being carried out, and that was that gas companies had not power to do such a thing. They would require to get special powers.

Mr. **Wyatt** remarked that he intended there should be a special company.

Mr. **Warner** said that was so. It seemed clear to them that there were very large profits on asphalt, tar pavement, and in the numberless other directions in which tar was being consumed, and that, in addition, they had their noble river, upon which products could be shipped from the gas-works at almost an enormous profit; but they had not the power to go on with it. Mr. Hardie had introduced a very important subject. It was one that had often been talked over; and he hoped the time was not far distant when it might be found to be to the advantage of gas companies, as well as of consumers, that there should be a combination of companies to work up the residual products.

Mr. J. **Hall** thought that the distillation of tar might be done in a combined way. Managers of large works might distil their own tar; but in small works it would be found to be very difficult. Some people said, " Put down the gas companies; " and electric light people said, " Let us extinguish them altogether." Why should they not therefore go into this matter, and so help each other ?

Mr. G. **Pettigrew** (Gateshead) stated that within the last eighteen months they had begun to manufacture sulphate of ammonia. Formerly they used to get £160 a year for their liquor; but now they made a profit of £600 out of it. He was of opinion that it would pay in small concerns to work up the products. The distillation of tar was a thing which he at one time intended to take up; but, for want of space, he had been obliged to abandon it.

Mr. **Wyatt** explained that, speaking generally, tar distillation could only be undertaken in large works. The nuisance was very great. At Beckton they found that in certain states of the wind the vapours were carried for three miles before they condensed and deposited. They had to make special provision to deal with it; and this a small company could not do.

Mr. **Warner** observed that within the last two or three months the large tar distillers on the banks of the Tyne had had to remove their works to the Wear; so that the produce of the many thousand tons of coal which were carbonized on the Tyne had to be carried over to the Wear to be worked up at a very great cost. This, in their own case, had absorbed a portion of the increased price they obtained for tar.

Mr. C. **Sellers** (York) said he should like to have just one word of explanation from Mr. Warner. He was in thorough sympathy with the proposal that there should be combination among gas companies for the distillation of tar; and, in his opinion, great advantage would arise from it. At his works only sulphate of ammonia was manufactured; and it might be difficult to get a combination to carry out the manufacture of sulphate. Mr. Warner had said that there would be some difficulty, as the companies had not the necessary legal powers to enter into a combination as suggested. He did not himself perceive where the difficulty came in. If the Acts of Parliament authorized gas companies to distil tar in their own works, he did not see the difference between that and transferring the power to works owned by a number of companies. He should like to hear Mr. Warner explain what he meant. If the thing were practicable, he should say that something ought to come out of this discussion; and he would propose that a Committee should be formed to consider how far it could be carried out, so as to test whether or not they could get the benefit which he believed they would have if any combination could be effected.

Mr. **Warner** said he was an engineer and not a lawyer; but to his mind it appeared that, when they obtained powers for a certain purpose, they had no power to manufacture anything else beyond the bounds which were scheduled. Their capital was raised for certain specific purposes; and he did not think it could be applied to any other object.

Mr. **Allan** (Wallsend) said he was afraid their shareholders would not agree to the proposal; and they would have to get an Act of Parliament giving them the necessary authority.

Mr. **Wyatt** stated that The Gaslight and Coke Company had formerly no powers to distil tar; but they went to Parliament and obtained them. In the same way, they could form a separate company in the North.

Mr. W. **Ford** (Stockton) pointed out that The Gaslight and Coke Company were selling gas at a very much higher price, though they manufactured their residual products, than did the South Metropolitan Gas Company. The analogy, he thought, might be carried farther; and it might be said that private undertakings might be better able to yield as good profits as would such large monopolists. He remembered the time when gas managers were allowed, as a perquisite, to manufacture residuals, for the sole purpose of getting rid of them; and his opinion was that, if gas manufacturers continued in the steady progress of their own business, the tar and ammoniacal liquor might be left in the hands of their employers. No one would say that ammoniacal liquor could not be distilled on the spot at a very high profit; but, on the other hand, there was such a diversity of opinion as to tar products, that he was very much afraid it might not pay gas companies or corporations to distil tar. After having been once or twice through the still, tar got into such a scientific class of article that no gas manager could attend to the elaborate processes that were required to produce the finer products, with a due regard to the duties to the public incumbent upon him as a gas manager. If they made him a scientific chemist, his duties as manager could not be looked after; because, as gas manager, he had to deal with the men in the retort-house and with the public, and the latter did not care whether or not the gas company made a large profit. It ought not to go out from the Association that the tar distillers had robbed the gas companies. ("No, no.") As a tar distiller, he knew something about it; and he thought he could interpret the remarks to mean that gas companies had been rather "diddled" out of their profits. It was the business of gas companies and corporations to manufacture gas as pure as possible, and to sell it as reasonable a price as they could; but he said let the day be far distant when they should form into a syndicate in a district to work up the tar. A corporation had no right to pledge their rates to come into competition with the private distiller. This country had been built up by individual effort; and if they ever came to the time when one man would manufacture for the whole universe, that would be a bad day.

Mr. Sellers disclaimed any intention of insinuating that tar distillers had been cheating them. No such feeling was in his mind, because, if he had insinuated that, it would have implied that gas managers were a set of simpletons, and men who did not know their business. There was quite sufficient competition among tar distillers to enable gas managers to get a fair price for tar. They saw that all businesses were now being carried on by combinations; and this would become more common.

Mr. HEPWORTH remarked that he did not agree with Mr. Hardie in thinking it desirable that gas managers should leave tar distilling alone. Why was it desirable, if the works were situated outside a town, where no nuisance could be complained of, and if they were sufficiently large to permit of the operation of tar distilling being carried on, that they should not engage in it? He dissented altogether from this conclusion. Then, as to the sliding-scale arrangement proposed by Mr. Hardie, he did not think it was in the power of man to conceive a fairer mode of arriving at the price to be paid for tar. It was very much wiser, he thought, for a gas company to accept short contracts, of (say) twelve months, for residuals, than to enter into contracts for such long periods as seven years. It would be found in the end, he believed, that a succession of short contracts entered into would have realized as good a price, on the average, as any other arrangement. Almost everybody was a sulphate of ammonia maker now-a-days. There might be gentlemen, however, whose make of gas was only (say) 5 million cubic feet per annum; and it was a question whether they should become manufacturers of sulphate of ammonia. He hardly thought they should. He certainly looked in the direction which had been suggested, of having a combination of works; but he believed legal difficulties stood in the way of their joining and forming a company for the distillation of tar. But that was a difficulty which could very easily be overcome, even if it required an Act of Parliament. What he would suggest would be an Act authorizing gas companies making tar to combine; and this should be obtained without very much difficulty. In Scotland, for instance, there were many small gas-works which had no Special Act of Parliament; and there was nothing to prevent them sending their products to such a combined works, and getting their *pro ratâ* share of the profits realized. There was one statement in the paper to which he had listened with some surprise, and it was this—that in one works as much as 32 lbs. of sulphate per ton was obtained. If he knew where these works were, he should be happy to go there, and get a lesson in sulphate manufacture, for he had never had so great a yield.

Mr. HARDIE, in reply, said he put it down, as a general rule, that gas makers should not be tar distillers; but if they could find a town where it would not be a nuisance, then they might possibly go in for it. In towns, however, of fastidious tastes, he thought it must be a very dangerous business to engage in. Mr. Wyatt's proposal for a combination tar-distilling company was an important one; but he rather agreed with Mr. Warner that they had no power for such a purpose. His mention of the 32 lbs. of sulphate per ton of coal was a detail; but Mr. Bower made 26 lbs. out of Durham coal, and this was very good.

Mr. Hepworth added that in some gas-works where sulphate of ammonia was manufactured, they purchased liquor from works where they did not manufacture; and the 32 lbs., or whatever the yield might be, was possibly calculated upon this, and not upon the quantity of coal carbonized in the works.

Election of Officers.

The President intimated that the following gentlemen had been elected to hold office in the ensuing year:—

President—Mr. Robert Wallis, J.P., Chairman of the South Shields Gas Company.

Vice-President—Mr. J. H. Cox, jun., of Sunderland.

Auditor.—Mr. J. H. Penney, of South Shields.

Secretary—Mr. W. Hardie, of Newcastle.

Committee—Mr. D. Terrace, of Middlesbrough; Mr. W. Hardie, jun., of Tynemouth; Mr. C. Sellers, of York; and Mr. W. J. Warner, of South Shields.

On the motion of Mr. Ford, seconded by Mr. Hepworth, a vote of thanks was accorded to Mr. W. Hardie, jun., for his kind and courteous behaviour in the chair during the year.

The President briefly acknowledged the vote; and this concluded the business of the meeting.

The members and friends afterwards dined together in the County Hotel.

SOUTHERN ASSOCIATION.

QUARTERLY MEETING, MAY 14.

This was the usual Excursion Meeting of the Association. The programme, which had been excellently arranged by the President (Mr. John Methven, of Nine Elms) and the Honorary Secretary (Mr. J. W. Helps, of Croydon), comprised a trip by rail to Windsor, and a drive through the Great Park from the Royal Borough to Virginia Water and back. The weather being delightful, the programme was carried out with great success. At Windsor, the party was welcomed by Mr. J. Wadeson, the Engineer and Manager of the Windsor Royal Gas Company, who conducted the visitors to the gas-works, situated adjacent to the Great Western Railway. These works being among the oldest in the kingdom, were found, as usual in such cases, to be much cramped for room. Mr. Wadeson was doing his best, with limited opportunities, to modernize his manufacturing plant; and with the assistance of his foreman, Mr. Simmonds, had designed a simple generator furnace, which was working remarkably well. The waste heat from the retort bench was made available for raising all the steam required on the works. After lunch, which was hospitably provided by the President, the party visited as much of the Castle as was open to the public; and then went on the drive down the Long Walk and through the Park as arranged. The members and their friends dined together in the evening at the Star and Garter Hotel, Windsor. Mr. Wadeson, Mr. Strange, the Secretary of the Gas Company, and Mr. Wadeson, jun., kindly acted as guides to the interesting places visited.

MIDLAND ASSOCIATION.

QUARTERLY MEETING, MAY 21.

The members of this Association had their usual excursion meeting on the above-named day; the places visited being Leamington and Warwick. The arrangements made by the Committee for the delectation of their colleagues, as set out in the programme issued by the Honorary Secretary (Mr. J. S. Reeves, of Bilston), were ably carried out; and everything passed off well. A fair number of members assembled at the Leamington Gas-Works about eleven o'clock, and proceeded in conveyances to Warwick Castle—one of the most perfect specimens of Feudal architecture in England. After inspecting this, visits were paid, under the guidance of Mr. W. T. Tew, Engineer and Secretary of the Warwick Gas Company, to the Leicester Hospital and St. Mary's Church. In the afternoon the return journey to Leamington was made by one of the most picturesque routes. On again reaching the gas-works, the members assembled in the Board-room, and, under the presidency of Mr. C. Stafford Ellery, of Bath, disposed of the business. Afterwards, Mr. W. Cross, Engineer and Secretary of the Leamington Priors Gas Company, described the process and arrangements which had been at work for some years for removing the foul smells from gas-lime previous to its removal from the purifiers. An interesting conversation followed the explanation. The members afterwards dined together at the Manor House Hotel. On the motion of the President, a vote of thanks was passed to the Directors of the Leamington and Warwick Gas Companies for their generous hopitality. Altogether a pleasant day was spent.

MANCHESTER INSTITUTION.

QUARTERLY MEETING, MAY 30.

This Meeting was devoted to an excursion to Beeston Castle—an ancient ruined fortress some ten miles from Chester. The members assembled at the Central Station, Manchester, whence the start was made. After a journey of a little more than an hour, Cuddington was reached. Vehicles were here awaiting the party ; and they set off for a drive through Delamere Forest to Tarporley, where luncheon awaited them at the Swan Inn. A further drive of two or three miles brought them to Beeston Castle, where an hour or two passed in lounging about the ruins. Excellent time was kept throughout the day; and punctually to the minute everybody was back at the Swan to tea. The day was set apart for pleasure; and the business transacted was of the least possible quantity. With the President (Mr. T. O. Paterson, of Birkenhead) in the chair, the minutes of the last meeting, read by the Hon. Secretary (Mr. S. S. Mellor, of Northwich), were confirmed; and then the names of three new members were submitted. These were Mr. H. H. Ford, acting Manager of the Macclesfield Gas-Works; Mr. R. Fearnley, of Rastrick; and Mr. S. Crossland, of Holmfirth. They had been duly proposed, and had been accepted by the Committee; and, on the motion of Mr. D. Clarke, of Ashton-under-Lyne, seconded by Mr. W. W. Hutchinson, of Barnsley, their election was confirmed. Thanks were accorded to the caterers for their attention; and on the proposition of Mr. Hutchinson, seconded by Mr. Newbigging, hearty appreciation was expressed of the arrangements made by the President, the Secretary, and Mr. Haddock, of Warrington, for the comfort of the party. Another charming drive by another and longer route, brought the members back to the station; and the journey by train to Manchester was the final incident of a delightful day.

NORTH BRITISH ASSOCIATION.

ANNUAL MEETING, JULY 23 & 24.

This Meeting was held in Edinburgh; the business being transacted in the Victoria Room of the Waterloo Hotel—Mr. R. ROBERTSON, of Bathgate (the President), in the chair. There was a good attendance of members; and the Association were favoured with the presence of Mr. W. A. Valon, Assoc. M. Inst. C. E., of Ramsgate, President of The Incorporated Gas Institute, and Mr. J. Hepworth, M. Inst. C. E., of Carlisle, the Past-President.

Mr. ROBERTSON opened the proceedings by expressing his pleasure at meeting the members in "the ancient capital of Scotland."

REPORT OF THE COMMITTEE.

The SECRETARY (Mr. R. S. Carlow, of Arbroath), read the annual report of the Committee, as follows:—

The Committee now present the annual report in the form agreed on at the 1885 meeting; and the following statement gives a general outline of the business done, with some notes that may be interesting.

The Committee, at a meeting held in Glasgow on the 15th of October last, resolved to alter the date for sending out schedules for the compilation of the annual statistical report, from Dec. 31 to July 31 of each year. The Committee's reasons for so doing are as follows: (1) That a more correct report would be got at July 31, as nearly all the annual meetings of gas companies and corporations take place, and the price of gas is fixed, in June and July of each year. (2) That both the annual report of the proceedings and the statistical report would be printed at one time and bound together, and thereby a considerable deal of trouble and expense saved.

The Committee have been again successful in obtaining the consent of Mr. Blair, of Glenfoot, Tillicoultry, to offer his two prizes—one of £7, and the other of £3—to be given to the authors of the two best prepared papers, "On the Advisability of Gas-Works Supplying Electric Light," and "On Utilization of Gas-Works Plant in the Making of Cheap Gas for Gas-Engines, for Driving Electric Lighting Plant, and for Heating, Cooking, and in Direct Supply to Steam-Boilers." Intimation of these prizes, along with conditions, was given to members in a circular dated the 6th of April last. The Committee have received one paper from a competitor for the prizes, which is still under their consideration. The decision of the Committee will be published in the annual report of the proceedings.

The Benevolent Fund has not been drawn upon this year.

The Annual Report of the Proceedings, 1890, was published and sent to each member of the Association, according to the rules. It contained the President's address, papers and discussions thereon, a list of Past-Presidents, new members admitted, names of members of Committee, rules, balance-sheet, &c.

The Committee, at a meeting held in Glasgow on the 19th of March last, took into consideration the two questions put into the question-box at the last annual meeting, and which were remitted to the Committee to be dealt with.

Question No. 1.—"In the event of a concrete tank leaking, what is the best means of finding out, and material for filling up same?"

The Committee, after discussing this question at some length, and giving it due consideration, unanimously adopted the following motion: "That the particulars or details of this question were so indefinitely stated, that the Committee thought it neither advisable nor judicious to give a direct answer thereto."

Question No. 2.—"I would like very much to be informed if it is customary for gas companies to provide and maintain at their own expense the underground service-pipes of street lamps; if not, what is the usual mode of dealing with such?"

The Committee had a long discussion on this question; and, after due deliberation thereon, the following resolution was adopted: "That the practice in regard to this question may vary in different towns; but the Committee consider that the service-pipes should be thoroughly and solely under the control of the company or corporation supplying the gas, and that any renewals or repairs should be carried out by the supplier of the gas, and so make certain that the loss of gas should be as far as possible reduced."

The Committee, at their meeting held in Glasgow on the 10th of April last, had under consideration the advisability of visiting the Aberdeen Gas-Works, in order to inspect and report to this Association as to the working of West's drawing and stoking machinery, and also the coal breaking and elevating machinery at work there. The Committee unanimously resolved that they should visit the Aberdeen Gas-Works for the purpose of inspecting the said machinery, and that the cost thereof should be charged against the Research Fund. Since the date of their inspection of the machinery at the Aberdeen Gas-Works, the Committee have been successful, through the instrumentality of Mr. Smith, of Aberdeen, in securing Mr. West, of Manchester, to read a paper at our annual meeting on his machinery; and Mr. Smith has also promised to take a prominent part in the discussion on the paper—giving his experience as to the cost of working that machinery as against the old system. The Committee therefore consider that a report from them on this subject would, to a certain extent, forestall Mr. West's paper. They have therefore resolved meantime to postpone giving any report; but those of the Committee who had the pleasure of seeing the machinery at work at Aberdeen will be better able to take part in the discussion on Mr. West's paper.

The Committee regret to announce that Mr. D. Bruce Peebles has seen fit to resign the office of Auditor to the Association; and the Committee have resolved, although with the greatest reluctance and regret, to relieve Mr. Peebles of the duties of his office, and have placed the name of Mr. R. B. Main, Glasgow, on the balloting-list as a fit successor to Mr. Peebles. The Committee have also resolved to recommend to the general meeting to-day that Mr. Peebles's name be added to the list of honorary members of the Association, in recognition of the excellent services he has rendered in being Auditor of the books for so many years, and otherwise contributing towards the success of the Association.

The Committee regret to state that they have been obliged to delete a number of names from the roll of membership, owing to deaths, parties resigning, and parties in arrear with their subscriptions. Still, it is gratifying to find that there are always a number of parties applying for admission as new members; thus showing that the Association is accomplishing the end for which it was originated.

On the motion of the PRESIDENT, the report was unanimously adopted.

THE ROLL OF THE ASSOCIATION.

The SECRETARY reported, with reference to the membership, that last year they had 156 ordinary, 61 extraordinary, and 5 honorary members, with 15 associates—making a total of 237. During the year they had had one or two resignations, &c., and several members had died.

The following gentlemen were admitted by the meeting as new members: Ordinary—Mr. J. Hepworth, M. Inst. C. E., Gas and Water Engineer, Carlisle; Mr. W. A. Valon, Gas and Water Engineer, Ramsgate. Extraordinary members—Mr. J. M'Kelvie, of Edinburgh; Mr. H. Darwin, of Glasgow; Mr. R. B. Whytock, of Glasgow. Associate—Mr. W. Stewart, of Brechin. The membership accordingly now stands at 233, made up as follows: Ordinary members, 151; extraordinary members, 61; honorary members, 5; associates, 16.

THE MURDOCH MEMORIAL FUND.

Mr. J. M'GILCHRIST (Dumbarton) handed in the report of the Murdoch Memorial Committee. They had, he said, clear funds in hand amounting to £317 17s. 6d. It had been proposed by the Memorial Committee, and had been accepted by the General Committee of the Association, that, next year being the centenary of gas lighting, they should do something with their funds in connection with Murdoch; and it had been proposed that they should apply to the Trustees of the Wallace Monument at Stirling, for leave to erect a bust of Murdoch, the inventor of gas lighting, in the Monument. There were already in that monument twelve very good Scotchmen; and if they were fortunate in getting the bust of Murdoch placed there, he could say that Murdoch would be in the right place, and in very good company. They had there already Robert Burns, King Robert the Bruce, John Knox, Sir Walter Scott, George Buchanan, James Watt, Hugh Miller, Adam Smith, Dr. Chalmers, Tannahill, Livingstone, and (last, but not least) Carlyle. He hoped the meeting would endorse the action of the Committee, and give them the necessary power to make their application. If all went well, he expected that next year, at the time of their annual meeting, they would be invited to attend the unveiling of the bust of William Murdoch in the Wallace Monument.

The PRESIDENT thought the suggestion by the Committee was a very good one, because, if carried out, the bust of the great pioneer of the gas industry would be located in a suitable place. He had much pleasure in moving that the report of the Committee be adopted, and that it be remitted to them to carry out their proposal.

Mr. A. MACPHERSON (Kirkcaldy), in seconding the proposition, said that the cost of the bust would only utilize a part of the money the Committee had; and they did not give up the hope of having a still more worthy memorial of Murdoch. In the meantime, however, he thought they might mark the centenary by carrying out the present proposal.

The recommendation of the Committee was agreed to.

THE FUNDS OF THE ASSOCIATION.

Mr. D. BRUCE PEEBLES (Edinburgh), the Auditor, read the Treasurer's report, which showed, in the General Fund, a charge of £143 18s. 1d., and a balance of £15 9s. 8d.; in the Benevolent Fund, a charge of £231 5s. 1d., and a balance of £222 17s. 1d.; and in the Research Fund, a charge of £83 17s. 10d., and a balance of £71 16s. 10d. He thought they might well congratulate themselves on having a very good showing this year—a better one than last. This year he had resolved to resign the office of Auditor. He thanked all the members for the courtesy and kindness he had received during the many years he had been amongst them.

The PRESIDENT said they had all listened with pleasure to the report by the Auditor. Their funds were in a position which augured well for the Association. He was sure they would be prepared to give Mr. Peebles their heartiest and warmest thanks for the great care and trouble he had taken in auditing the books—not for this year only, but for the 15 or 16 years he had been their Auditor. He proposed that they should give him their thanks, that this should be recorded in the minutes, and that they should make him an honorary member, which was the least they could do.

Mr. M'Gilchrist seconded the motion. He said he felt that, altogether apart from Mr. Peebles's services as Auditor, he had, as an inventive genius, been a credit to the Association.

The motion was agreed to.

Mr. Peebles thanked the members very sincerely for electing him an honorary member, an honour which, he said, had come upon him unexpectedly, and he might say very undeservedly, for he could not think he had any reason to expect it.

The President then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—I thank you very sincerely for the great honour you have conferred upon me by placing me in the President's chair at this, our thirtieth annual meeting. I value the honour all the more when I consider my position among you—a Manager of one of the smaller gas-works. While honoured and pleased, I feel the task of saying anything worth listening to a difficult one, more especially in these times when presidential addresses of much merit are being reported almost weekly. I seem not altogether in my right place; and I think one of our number, more capable of giving an original address founded upon his every-day experience in a larger field of labour, might have been chosen to address you. I anticipate, however, your kind indulgence, and also your help, in carrying out this day's programme.

The continued prosperity of our Association must be gratifying to all of us. Its steady onward progress, always keeping abreast of the times, shows clearly its adaptation to the object for which it was instituted—viz., "For the encouragement and advancement of all matters connected with gas engineering and manufacture, and to facilitate the exchange of information and ideas amongst its members." This object has been carried out year by year since the Association was formed; and no small part of the progress of the gas industry is due to these and suchlike fellowship meetings, and the subsequent intercourse between gas managers brought about by the meetings. When we contrast the present with the past, and think of the good fortune of the young gas manager of the present day, we cannot help expressing the hope that he may fully appreciate and make the most of the advantages which the increased facilities of acquiring knowledge bring to him. It is a matter of surprise to me that so few young Scotchmen, who are doubtless looking forward to the time when they may fill our shoes, put the study of the details of their profession to the test by entering for the City and Guilds of London Institute Examinations in "Gas Manufacture." A few have entered and passed well, but comparatively few; and I do not see why it should not be otherwise. The passing of such an examination will not make a manager. But the fact of his having passed shows he has a grasp of the subject he has been studying; and when this is combined with practical experience, it must make him all the more efficient.

It is a matter for congratulation that the demand for the commodity we manufacture and sell is still largely on the increase (notwithstanding the encroachments of rival illuminants), and that gas stocks are to-day as firm as ever they were. The confidence in them, shaken somewhat when the electric light was first brought forward, has been regained, and to all appearance has been much strengthened—to the annoyance of the timid people who sold out when the scare about the new light was in vogue. The demand for coal gas increases amazingly year by year; showing that gas is still the good, old, and tried friend of the public. The statistics of the gas manufactured in the capital in which we are now met, need only be mentioned as exemplifying this fact. Compared with last year's production, there is an advance of 100 million cubic feet; and the same rate of increase has been recorded in many of our large centres. And, further, we rejoice that a good part of this is due to extra day consumption. The prejudices against gas as a cooking agent have been gradually removed; and what was claimed by us years ago is now admitted on all hands—that gas is the most economical, convenient, and cleanly mode of cooking yet introduced.

I dare say the majority of you will have had a like experience to my own in the matter of gas cooking-stoves. I have not yet had returned one of those sent out from our works on hire; and with few exceptions they have been eventually purchased by the hirers, which itself speaks well for the success of gas in that department. The extra day consumption is also attributable in part to the success of the gas-engine; and on the expiration of the patent rights, we hope to see a more general use of this motive power. The high price of the engine—not only its first cost, but the high price of the new slides required periodically—is the most serious drawback to its introduction. Gas as a motive power having been proved to be more economical in practice than hydraulic or electric power, and much more reliable than the latter, it will, I am sure, on the removal of this barrier, come still more into use. We cannot say that the same perfection has been attained in the application of gas to heating purposes. The ideal has not been reached here; and, with the exception of its use as a water heater, gas has so far failed to supply the place of the coal fire on the score of economy. So there is still scope in that line for the inventive genius of our gas engineers and stove makers.

Looking from the past success of gas to its future, and remembering that this success up to the present has been due to its cheapness, reliability, and convenience, we may question ourselves as to the possibility of this increasing demand being reversed. We need not consider the possibility of any rival illuminant ousting gas on the score of reliability and convenience. There is none. But what concerns us most is the danger of a decreased demand, induced by a necessity for raising the price to such a figure as would give the more expensive and brilliant light a chance to supplant it. Cannel coal, on which we just now entirely depend for our present supply of good gas, has, during the past year, risen in price to such an extent as to cause the majority of gas companies in Scotland to advance the price of gas. These advanced prices are still outside the competitive range of electricity and oil. But there is every prospect of a still further increase, owing to the Continental demand for high-class cannels; and keeping in mind that cannel is becoming year by year a more limited commodity, we cannot look for anything but still higher prices. To reduce the present high standard of luminosity by the use of cheaper coal, that gas may be kept at a low price, would, in my opinion, be a false step, in the face of the continued demand for more light. The efforts put forth by our American brethren to produce gas of high luminosity, so as to compete more favourably with the electric light, confirms the opinion of the majority of Scotch managers, who hold that a high standard of illumination ought to be maintained, and shows us that there is perhaps, after all, a great amount of truth in what the chairman of one of the electric light companies said in explanation of the non-success of the new light in Scotland—viz., owing to its being there met by a strong competitor in the shape of the rich coal gas supplied.

Being brought face to face with the difficulty of producing a rich gas at a cheap rate when cannel is rising in price, it is gratifying to see that there is a possibility of the removal of that difficulty. The activity shown by gas managers and chemists in their endeavours to practically apply the old theory of enriching coal gas by oils, is significant. That the many difficulties hitherto encountered in this direction will ultimately be overcome, I have not the slightest doubt. Success in this, combined with the introduction of more economical methods of working, will enable gas to hold its own as the cheapest light for years to come.

Turning to the progress of our rival illuminants, foremost, though not most formidable, we must place the electric light. Its progress during the past year has in no way curtailed the sale of gas; and I think we may yet safely place the electric light in the same category as it has been in since its introduction —the "light of the future." Unless the cost of its production can be very much cheapened, we have no reason to fear encroachments of the electric light, either in private dwellings or in our streets; and cheapening seems scarcely possible when we consider that at the present time upwards of 90 per cent. of the power expended is converted into light. It is also a significant fact that week by week we read of local boards and corporations who have adopted the new light, falling back upon gas as being more economical and reliable. The great field of the electric light appears to be for advertising purposes, and as a luxury to those who are willing to pay for it.

Leaving this competitor, and coming to our less brilliant rival, paraffin oil, we find in it an opponent of a far more serious kind. In our smaller towns, distant from the coal-fields, the rivalry of oil is much felt, owing to the necessarily high price of gas. In our larger towns and cities also this opposition, although perhaps not felt, exists; many of the well-to-do people adopting oil because of erroneous views as to its superiority over coal gas. The difficulty of meeting this competitor in the first case is not an easy one for the gas manager. A consumer is able to buy a bottle of oil for 1½d. or 2d., but a quarter's gas account would appear ruinous to him. It is needless to point out to him the relative lighting values of gas and oil; for, as a rule, he is content with a smaller light when burning oil than he would be if using gas. The only solution of the difficulty seems to be the placing of the gas consumer on the same footing as the oil consumer, by adopting a system of short payments, either by weekly collection or by prepayment meters. I believe Mr. Keillor, of Nairn, has applied the principle of weekly payments successfully among a class of consumers who would otherwise have resorted to oil; and other managers similarly placed might take the hint and do likewise. With regard to oil as a competitor of gas among the better classes, it would be well if the attention of these classes could be drawn to the fact that, in the burning of our ordinary commercial Scotch paraffin oils and petroleum, more sulphurous fumes are given off (to the extent of 20 to 60 per cent.) than by burning coal gas; and I think no better way of enlightening them on this point could be found than by the circulation of the excellent paper read at one of our meetings by Mr. A. Bell, of Peebles, on "The Presence of Sulphur Compounds in Illuminating Mineral Oils." * It would be well for us who feel this opposition to get this paper (which is in pamphlet form) and make good use of it.

The facts arrived at by Mr. Bell, after careful experiment, thoroughly confute the statement made in a booklet issued by a large firm of lamp makers in Birmingham, who always keep their country merchants well supplied with literature showing the advantages to be gained by adopting their goods. After describing the advantages oil-lamps have over gas—as being more easily carried about from place to place, and so on—this pamphlet says: "But lamps possess some other very decided advantages over coal gas, inasmuch as they do not load the atmosphere with sulphurous fumes; leaving the air much purer for breathing, while the books, pictures, brass fittings, and hangings do not become affected as in rooms where gas is burned." It has been demonstrated that paraffin oil or petroleum, burned under the best conditions, gives off sulphurous fumes to a great extent. But there is an additional drawback to its use, in the disagreeable smell that arises from its incomplete combustion (not to speak of the unpleasantness of handling the oil itself); for in four cases out of six, consumers do not know how to clean their burners, or do not care whether they are cleaned or not—unless, perhaps, they get a rub up on the outside. The result is that disagreeable fumes are given off peculiar to the houses where oil is burned. The gas consumer notwithstanding that his education in the burning of gas to advantage is somewhat deficient, is better placed than the oil consumer.

We also find that paraffin oil and petroleum have entered the field as competitors with gas as producers of motive power. These oil-engines will be extremely handy in places where there is no gas; but I am afraid they will have no chance alongside the gas-engine.

In keeping our own in this rivalry with oil and electricity, our attention cannot be too often drawn to the necessity for us making the education of our customers in the use of gas one of

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* See *Journal of Gas Lighting*, Vol. LIV., p. 403; and "Reports of Gas Associations" for 1889, p. 209.

our chief duties. We should see that the pipes put into new buildings are large enough, and point out to the proprietor the benefit he will derive by supplying himself with fittings of a substantial and sufficient kind; and to all our customers we ought to show the greatest courtesy—attending promptly to any grievance, so that they may see that we are working for their interest as well as for our own.

In addition to paraffin oil and electricity, we have in the field other illuminants; but these we can hardly place under the head of rivals. I refer to water gas and oil gas. By themselves these gases have not been a commercial success, whatever good fortune there may be before them in combination with coal gas. The "hue and cry" about water gas raised a year or two ago has died down almost as speedily as it got up. The statements about its low price have been proved to be very much exaggerated; and, unhappily for the shareholders, it may safely be concluded that it has been found impossible to produce it on such an economical basis as was prophesied. I had an opportunity of looking into the works at Uddingston some time ago, and I cannot say that I was favourably impressed with the light. I suppose its manufacturers do not care to see intruders, for I had no opportunity of testing its illuminating power. Gas made from oil directly, although in the field, like water gas, for many years, has not been made at a cost low enough to enable it to enter into competition with coal gas, although the promoters of the many schemes for its production have, by a manipulation of figures, endeavoured to show, from its enormous illuminating power, how much more valuable it is than coal gas. In addition to the extra cost per 1000 cubic feet, there is the drawback of its impurity. One of the "facts" stated is that it is "free from sulphur, ammonia, &c." But, unfortunately, these "facts" will not stand investigation. Reference has before been made at our meetings to the large amount of sulphuretted hydrogen present in gas made by these systems.

The Gas Company at West Calder have recently adopted the "Mansfield process" for making gas from oil. The town has been supplied with gas from Young's Paraffin Oil-Works there for a number of years back; but the local Company, having found they were not getting the gas at a remunerative price (so much being lost through condensation between the oil-works and the holder—a distance of fully a mile), looked about them to see if another method could be adopted. Unfortunately, the lease of the ground on which the holder is erected is so drawn up as to prevent the Company erecting retorts for carbonizing coal. The Superior was approached to see if any arrangement could be come to with him; but the only concession he made was to allow the erection of plant for making oil gas. The whole system is complete and easily wrought, and a great improvement over some other oil-gas apparatus, in so far as the gasholder rises under pressure instead of vacuum, as in the other kind.

The apparatus consists of a circular generator, in which is placed an iron retort of much the same shape as the ordinary laboratory glass retort. From this the gas is led to a hydraulic box, and thence to the holder. The oil is run from a small cistern overhead into the retort, where it is decomposed and converted into fixed gas. There is no purification; the gas being led direct from the hydraulic box to the holder. The method is extremely simple; but, as you may suppose, the gas is not free from sulphuretted hydrogen, although the makers, in their prospectus, give out that the gas is "quite free from sulphur, ammonia, or sulphuretted hydrogen, and consequently is purer than it is possible to make coal gas."

I am afraid oil gas by itself has proved to be neither so economical nor nearly so pure as coal gas. In combination with our present mode of carbonization as an enricher, we may, however, look for it to become in a short time a very valuable adjunct. The many schemes which are now on trial, and which have been fully described lately, will be watched by us very attentively, in order to ascertain their merits.

Having dealt in a rather desultory manner with things outside the works, I will now look at some of the recent improvements that have taken place in gas-works plant. Beginning with the retort-house, this section of the works seems to be undergoing a thorough revolution, however slowly. Only ten years ago the system of regenerative firing was comparatively unknown; but to-day the advantages of this mode of heating have been so well proved, that its adoption has been very general, not only in our large, but also in our smaller works. There are now few works that are not laying aside the old wasteful method as a thing of the past. Our attention is to be drawn to this system of firing in a paper to be read to-day.

The system of inclined retorts reminds us of the oil-works benches we see in many parts of Scotland. That the plan has great advantages is quite apparent; but it comes to a point whether that or the present system of horizontal retorts, with the addition of drawing and charging machinery, is the more economical. From practical experience, it would appear that both systems are very much on the same footing with regard to economy; and if so, there is every chance of the present system of horizontal retorts, with the addition of machinery, having the preference. The managers of the smaller works will have to rest content with drawing and charging by hand for some time; this being, in their case, as yet, the most economical plan. Talking about improvements in retorts, I am surprised that nothing further has been done to carry out the combination of horizontal and vertical retorts for the recovery of ammonia from the coke, or the production of water gas for firing purposes, as was suggested by Mr. William Young at one of our meetings some time ago.

Passing on to purification, it must be a matter of regret to us that purification in closed vessels has not been so successful as was anticipated a few years ago. By this time we expected all the disagreeable odour from the changing of purifiers would have been obviated; but our expectations have not been realized. Difficulties in the practical working of the system have cropped up, and debar it at present from being a complete success. The partial failure of this scheme does not affect us further than the regret we have at seeing such an ideal form of purification hampered in its working; for the present system of dry purification has been so much improved of late as to make us content with such things as we have. The introduction of air or oxygen for the continuous revivification of the purifying materials has done much towards avoiding nuisance.

The labour troubles still cling to us, and it seems that a solution of this difficulty will not be arrived at in a hurry. The spirit of unrest among gas workmen, as well as in other departments of labour, kept up by the paid agitator, is a matter of anxiety to the gas manager. It is to be hoped that, with his usual tact and fairness, he will be able to overcome this difficulty in the coming winter.

The better state of the bye-products market must be consoling to us, in face of the advance that is taking place in the price of coal. We trust there is some truth in the report that the sources of nitrate of soda are failing. This, combined with the tendency there is on the part of farmers to return to sulphate of ammonia as a manurial agent, bids fair to bring sulphate up to a more remunerative price. It is now generally known among farmers that the fertilizing power of sulphate is greater than that of nitrate; and I hope the Sulphate Association will make the most of the excellent paper read at The Gas Institute meeting this year by Mr. Ritson, of Jersey.*

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* See *Journal of Gas Lighting*, Vol. LVII., p. 1304.

An effort should now be made to complete the sum necessary to raise a fitting tribute to the memory of our great pioneer, William Murdoch. Next year will be the centenary of the advent of gas lighting; and it would be a fitting time to get this done. I am sure I shall not appeal to you in vain, but that you will all willingly re-subscribe, and have completed next year what has been our desire for some time past. We surely cannot grudge a little for the purpose of seeing something done to perpetuate the memory of the man whose name we all revere, and who, by the introduction of gas lighting, did so much for the advancement of civilization.

I cannot close my remarks on this occasion without referring to the loss the Association has sustained through the deaths of Mr. G. Niven, Gas Manager, of Airdrie; Mr. Thomas Elliot, Gas Manager, of Kirkcudbright; Mr. James M'Kelvie, Coalmaster, of Edinburgh; and Mr. Henry Walker, Coalmaster, of Bathgate—all members of our Association, who though not taking so active a part in its work as others, had a deep interest in its welfare. On your behalf I would express the sorrow of the Association at their loss, and its sympathy with their bereaved relatives.

I thank you for the very patient hearing you have given to these somewhat rambling remarks on some of the present-day topics of the gas industry; and hope our Association will go on flourishing in the future as it has done in the past.

Mr. W. A. VALON (Ramsgate) said he had much pleasure in proposing a vote of thanks to the President for his address.

The motion having been cordially agreed to,

The PRESIDENT briefly thanked the members.

Mr. G. R. HISLOP (Paisley) then read the first paper, on

A NEW FORM OF GAS-BURNER SPECIALLY ADAPTED FOR GAS-TESTING PURPOSES.

Gentlemen,—It is just three years since I had the privilege and pleasure of laying before the members of this Association my views upon a new departure in the construction of union gas-burners,* and proved to them, by a tabulated set of experiments, the importance of the principles I then propounded—viz., that the angle of impingement of two jets of illuminating gas has a most important bearing upon the character of combustion and intensity of light emitted by such gas. I pointed out also the insuperable difficulties experienced in procuring test burners having their orifices drilled at certain angles. To-day I purpose following up this subject a little further, and showing you how I propose to overcome the difficulties referred to. It is just possible I owe an apology for again introducing this subject; but the importunity of your President must be charged with the infliction, should it prove one. I may state that the instrument which forms the subject of this paper was designed by me in connection with my former paper; but the time then at my disposal did not permit of its production. I am, however, not without hope that its production now will meet with some measure of appreciation from the members of the Association. This instrument I have designated "The Angleometer Union Gas-Burner." The practical application of it I shall endeavour to explain to you.

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* See *Journal of Gas Lighting*, Vol. LII., p. 205; also "Reports of Gas Associations" for 1888, p. 158.

In my former paper I pointed out that, in order to carry out my experiments upon the various qualities of gas, I was compelled to have a considerable series of burners specially made to suit various qualities of gas ranging from about 18 to 32¼ candles, and having their orifices drilled at different angles off the vertical line. All this is now, however, admirably accomplished in this one burner; supplying as it does a most effective and speedy means of producing the angle of impingement under which any quality of gas will emit the highest intensity of light consistent with, or in conformity to, the existing statutory regulations contained in the various Acts of Parliament. To find the angle, therefore, at which any quality of gas ought to be tested, it is only necessary to alter the inclination by means of a screw adjustment; and this may be accomplished by two methods. The adjusting mechanism necessarily secures constant contact of the burner tips, as also the orifices at a fixed distance; and this secured, it is necessary only to increase or reduce the angle of inclination to produce a flame having the exact extent of elongation, and so as to be just under smoking-point.

The importance of securing such a uniform condition while testing all qualities of gas, will be at once apparent—a point which, in the tabulated experiments, I proved to you affects the luminosity of the gas to the extent of from 0·11 to 0·18 candle for each degree on the series of tests made. Taking, for example, a gas of 22·25-candle power, I showed you that the angle of 22° off the vertical line, or a total angular distance from each other of 44°, gave the highest result obtainable; the dimension of the flame being $2\frac{7}{16}$ inches broad by $3\frac{9}{16}$ inches high, while with the same gas tested with the impinging jets placed at an angle of 45° off the vertical line, or a total angular distance from each other of 90°, producing a flame $3\frac{1}{16}$ inches broad by $2\frac{9}{16}$ inches high, the lighting power was reduced to 19·71 candles —being a loss of 2·54 candles, or 11·42 per cent., or 0·11 of a candle per degree over the whole series of tests made on the gas of this quality. Similarly, gas of 23·8-candle power was found to lose, between the angles of 24° and 45°, 2·53 candles, or equal to 10·63 per cent. On a gas of 26·29-candle power, and tested between 28° and 45°, the loss was 2·51 candles, or equal to 9·55 per cent. Again, with 28·4-candle gas, tested between 33° (as the most effective angle) and 50°, the loss was 2·4 candles, or equal to 8·46 per cent. Gas of 30·28-candle power, tested between 38° and 50°, showed a loss of 2·16 candles, or 71·4 per cent.; and, finally, 32·6-candle gas, tested between 45° (as the most effective angle) and 55°, gave a loss of 1·8 candles, or equal to 5·6 per cent. It will thus be seen that the loss and liability to error are greater in the case of the lower qualities of gas; but this is as may be expected, since with the latter there is much greater liability to over-oxidation. Again, burners are generally made with their orifices drilled at angles much too high for the lower qualities of gas. The risk of error and loss are consequently much greater in testing the latter.

Having now so far explained to you in words the difference due to angular distance, I proceed to give some ocular proof of the force of my statements. The instrument before me is set to the angle of 47° off the vertical; and you will observe that the horizontal dimension or breadth of the flame is much more than the vertical height. Presuming the quality of Edinburgh as to be actually 27 candles, the illuminating power of 5 cubic feet will be, as I am now consuming it (say), 24 candles. But if I now alter the angle of inclination of the jets to 28°, as being the most effective angle for that quality of gas, the illuminating power would be raised to 27 candles; the difference representing a gain of 12·5 per cent. The alteration of the angle, you will readily observe, produces a very marked change, not only upon the dimensions of the flame, but upon the amount of light emitted from it. It will thus be seen that the "Angleometer Burner" embraces the entire range of angles under which my former experiments were conducted, or are ever likely to be required in testing illuminating gas. The practical result of the elongation of the gas-flame is the combustion of the gas under conditions equivalent to a reduction of 2-10ths of an inch pressure at the point of combustion, while the pressure of 5-10ths is maintained in the jet. This burner therefore offers great advantages to all gas examiners and managers in testing any quality of gas; and since every quality has its appropriate angle, the instrument is speedily adjusted to that angle at which it will show the highest amount of light compatible with, and in due conformity to, existing Acts of Parliament regulating gas supply.

But some may be inclined to ask the question whether, after all, the burner answers the description of a union gas-burner as defined by the Board of Trade. I answer, "Most certainly; it is truly a union jet, but with adjustable angles." Angles in relation to quality have hitherto never been thought of, and consequently never defined; and thus the matter of angular inclination of the jets to each other has been left entirely to the mercy of will or accident, as the case may be, only the burner shall have two holes (which constitutes a union jet), just as a human being has two eyes, but with the result not less varied than the visual power of the human eye itself. Such Acts of Parliament should consequently in the future contain a qualifying clause, to the effect that the standard 5 cubic feet of gas per hour "shall be tested by a union jet capable of relative angular adjustment, in order to the perfect combustion of the gas."

After what I have stated, it will be readily conceived as possible to construct a scale of flame dimensions which shall approximately indicate the illuminating power of 5 cubic feet of any quality of gas; and this I hope to accomplish.

It is almost unnecessary that I should dwell longer upon the principles I have enunciated in this and in my former paper. Much has been said and written upon the question of gas-burners for general use, and many attempts have been made to introduce reform. But however much has already been done, burner makers are not easily enticed out of old beaten paths. I find, for instance, that many difficulties are said to be in the way of making burners of the various angles required, although I fail to see why it should be so; and I am not without hope that these principles will be carried out in practice.

My special business to-day, however, is to provide the gas manufacturer and analyst with the best means of determining the illuminating power of all qualities of gas, and that under exactly uniform conditions, considered in relation to the composition of the gas. I have already shown you that the range of error or loss in testing gas—say, of the quality supplied to this city—amounts to 3 candles. But assuming that only one-half of this loss is sustained by defective angular impingements of the gas-jets, we have 1·5 candles loss, which I confidently affirm is not overstated. With gas as now supplied here at the rate of 4s. 6d. per 1000 cubic feet—but taking the actual cost to the Corporation at 3s. 6d. per 1000 cubic feet—for 25½-candle gas, as now tested by the best means available, we have the rate per candle of 1·55d. exactly on the average, but in reality something like 2d., as the cost per candle within the range of error indicated, owing to the higher class of coal required for its production. Now, 1·5 candles at 2d. per candle equals 3d. per 1000 cubic feet, which, on the quantity of gas sold in Edinburgh and Leith during the past year—viz., 1,239,973,000 cubic feet—amounts to £15,499 13s. 3d.

It is unnecessary to point out that such loss does not apply to this district alone, but to all corporations and gas companies supplying similar gas (the one I represent not excepted). But where lower qualities are supplied, the loss may be much greater. This loss, however, it will be borne in mind, falls in the first instance upon the gas manufacturer, and not upon the consumer, as presently considered. My purpose now is chiefly to show the means by which the gas manufacturer is justly entitled to take credit for supplying to gas consumers a much better article than he has hitherto had credit for, and at the same time conforming to the conditions of proof as to quality contained in the Act of Parliament or otherwise. No doubt the effect would be to increase the difference of loss as between the results so obtained and those realized in ordinary domestic and factory lighting; but I have the satisfaction of having, in my former communications, propounded a remedy, to some extent at least, for such loss in their case also, which might be carried out if only "time" to me and "the will" were present with the burner manufacturers. In the meantime, I content myself with having directed your attention to certain important and hitherto overlooked conditions, which I have endeavoured to prove are all-important to you and to me in their financial and economical aspects.

While the instrument which has been the subject of this paper is specially applicable only to gas-testing purposes, I propose to make it at the same time applicable for ordinary use, as, whatever rights we may claim for ourselves as gas manufacturers, the claims of the gas consumers must ever receive our special consideration. As I stand before you to-day, I have fresh upon my memory the first paper I read in the interest of gas consumers, to the members of this Association, and in this city, 23 years ago, when I enunciated my views upon what may be regarded as amongst the first attempts at the so-called modern system of regenerative gas-lamps—viz., that of covering the tops of all gas-shades, and furnishing them with a controllable ventilating device, so as to consume the gas in a heated atmosphere—a system which was recently made the subject of a patent by a Glasgow gentleman.

And now, while thanking you for your attention, I have only to say I shall be glad to further explain, to any who may desire it, the principles and working of the "Angleometer Burner."

Discussion.

The PRESIDENT said the members had heard the paper, and followed out the details of the illustrations, and he hoped they would discuss the points of the communication.

Mr. D. BRUCE PEEBLES (Edinburgh) said that everything Mr. Hislop brought before them always showed a great deal of honest and hearty work. He had gone into this question very ardently, and in the paper he had read that day had shown clearly that he had attacked a subject of very great importance to gas producers and consumers. He thought, however, that in the instrument exhibited, he saw a little bit of a grandchild of his own. Many years ago he produced an appliance wherein two gas-burners were automatically arranged so that they left one another and then coalesced. Some years afterwards he read a paper to the Association, and exhibited before them an arrangement in which two burners were brought together so as to show the increased illuminating power by this operation. This could be arranged at certain angles; and he must say that Mr. Hislop had followed this up, and produced a very beautiful instrument, which would very much more clearly give the different angles required. The difficulty he (Mr. Peebles) found in connection with burners was to know what the various angles should be for different qualities of gas. This was a point which had been very clearly brought out. He could remember the type of flame that Mr. Hislop had just shown. It was known all over the world before Mr. Bray brought out his burner. Mr. Bray produced a flame of more brilliancy, but of less illuminating power. Mr. Hislop's paper was so interesting, that it should lead to a great deal of discussion. There was no doubt the ideas put forth had been brought out before in London; and they might be taken up now in connection with Mr. Hislop's method of increasing the illuminating power of gas. He (Mr. Peebles) remembered very clearly Mr. Hislop's former paper, and that he gave them a very good illustration of the necessity, in burning gas, of allowing the proper quantity of oxygen to go through to secure perfect combustion. There was another point which was brought before them long ago by Mr. Hislop in connection with this matter—what was called the Methven screen. Mr. Hislop long ago employed a similar method, where the hole, instead of being rectangular, was simply circular. Mr. Fiddes, of Bristol, deserved the credit of having introduced that system.

Mr. A. Smith (Aberdeen) asked if the same quantity of gas was being consumed in the first flame shown as in the second. He thought Mr. Hislop had stated that the pressure was 5-10ths in the first flame, and reduced to 3-10ths in the second. The former appeared to him to be a little "wiredrawn;" and the latter he did not think would be a pleasant one to the eye. If, however, they could get anything to raise the quality of the gas 3 candles, it would be a great thing indeed.

Mr. R. Mitchell (Edinburgh) said that Mr. Hislop had very kindly referred to the quality of the Edinburgh gas. Perhaps it had not been his fortune to have to experiment with the same quality of gas, and therefore his burner did not altogether suit the Edinburgh gas. They strove at all times to give 27 candles illuminating power; but in the West they only supplied 18, 19, and 20 candle—nothing more. He thought if Mr. Hislop had had a little more experience with the Edinburgh quality of gas, he might have had a more efficient burner to suit it. They were, however, very much indebted to him for bringing the subject before them, for he had been very successful with his arrangement. It was one of those things which might, in due time, come to be of service to the general public.

Mr. A. MacPherson (Kirkcaldy) thought that the members all acknowledged that they were indebted to Mr. Hislop for his present paper, and also for that he read on a former occasion. He (Mr. MacPherson) considered that in the last paper Mr. Hislop had very clearly demonstrated to the Association the great benefit to be gained by having burners pierced at various angles for different qualities of gas. This, he thought, Mr. Hislop had carried a step forward; and although at that time he was unable to illustrate what he had found to be the case, he showed it to them that day, and he (Mr. MacPherson) considered he had clearly made out his case. He thought they had only to look at the second flame, and compare it with the first, to see the difference between the two. He was of opinion the illuminating power of the second flame was superior to the one they saw before the altering of the angle. He thought Mr. Mitchell must have misunderstood Mr. Hislop's description of the burners, because it clearly pointed out that with a richer gas the loss was not the same as with a poor gas, and the benefit was the greater the poorer the gas. He (Mr. MacPherson) also considered that Mr. Smith had not comprehended Mr. Hislop. As he understood the paper, there was the same pressure and the same quality of gas in both cases; but Mr. Hislop would be able to enlighten them on the matter. He thought they could see for themselves, with the naked eye, that the illumination afforded by the same quantity of gas arranged at one angle was superior to what it was when burning at another angle. Mr. Hislop deserved their thanks for the manner in which he had investigated the question of gas-burners; and nothing would tend more to give satisfaction to the consumers than a proper set of burners constructed on the principle advocated, suitable for all qualities of gas, from 18 up to 27 candles. A good idea was that the consumers should be supplied by the gas companies with burners specially adapted for the gas manufactured by them. In this way, not only would a benefit be conferred on the companies, but the advantage would be extended to their customers. If they were able to make 25-candle gas appear to be of 27-candle power, so much the better for the companies; and if they could develop a candle or two more for the same consumption, so much the greater saving for them. His opinion was that they should do all in their power to encourage Mr. Hislop.

Mr. PEEBLES asked Mr. Hislop if he had tried the effect upon the burners of very low pressure at these great angles. Would the low pressure not bring a corresponding type of flame, even although the angle of the burner was much greater than was illustrated at present?

Mr. J. WEST (Manchester), while acknowledging that the subject of burners was a very important one, said he did not set out to argue the point raised as to the angles, because it was one on which he had not experimented. He had, however, made a large number of tests with burners; and he thought there was a great deal in the question about low pressure. He made experiments a few years ago on every burner he could procure, and he read papers in Manchester on the burners actually in use in the city as compared with modern kinds. He found that, with the burners the consumers were using, the gas had an illuminating value about 30 per cent. less than it was capable of giving. He sent men out to collect burners in the city, and then compared them with the modern types. He gave the members this explanation to show them that the question before them was an important one. The conclusion he arrived at was that every burner should be governed. This was a question which gas manufacturers should take up, so as to show the people what burners they should have. They could do more in this way in pushing out the electric light than in any other. They should advise people to purchase the best burners; and if they did not follow this advice, let them have the burners for nothing.

Mr. VASS (Portobello) asked a question regarding the relation between the angle and the illuminating power of the burners. He said they had at present some testing appliances, but they were all very expensive. What was wanted was an instrument suitable for small works; and he thought the one before them might be utilized in that way.

Mr. W. KEY (Tradeston, Glasgow) said that the arrangement shown struck him as very well adapted for the purpose for which it was designed. The way Mr. Hislop directed the nozzles on to each other was one which must seem to them all to be very simple and effective. As to Mr. Vass's suggestion, he was afraid such a thing could not be. One thing had been mentioned by Mr. West, which was, he thought, at the root of the whole matter of the angles, and that was the velocity with which the gas approached the point of combustion, by having a tube wide enough instead of the old narrow burners. As an illustration, he mentioned Bray's "Special," where the tube was very wide, and they had a very slow, sluggish flame. This was what Mr. Hislop wanted, so as to have the best development of light they could get at the time. He considered Mr. Hislop had succeeded most admirably, and deserved their thanks for the admirable instrument he had designed.

Mr. J. BALLANTYNE (Rothesay) expressed the opinion that what was really wanted was a burner which consumers could regulate for themselves. He would like to know, however, if Mr. Hislop would give them some idea as to the cost of the burner. The drawback with consumers was that the cheaper the burner, the more demand there was for it; and if it was costly, the consumer would not have it. If Mr. Hislop's burner was cheap, they could induce consumers to purchase it.

Mr. W. EDWARDS (Renton) asked if an attachment could not be made to the burners, so as to regulate the flame; it seemed to be very unsteady and trying to the eyes. This was the reason for so many students and others using reading lamps.

Mr. HISLOP, in reply, said he was very pleased his paper had elicited so much discussion. Mr. Peebles's experiment was one to indicate the difference between the original rat-tail burner and the union burner. The first form of burner made was only a jet just as straight as a pencil. A departure was made from this and a burner was invented called the "union jet," which made two jets into one at certain angles. At the same time, he (Mr. Hislop) thought it was a long way from showing how the angles could be altered so as to produce a flame of different dimensions. Mr. Peebles asked a question about tests with low pressures to get the same result. He (Mr. Hislop) believed it would be so. Then as to the question put by Mr. Smith, of Aberdeen, as to the same quantity of gas being burned under the same pressure, he explained that it was so. He might tell the members that the burner (tested before he left Paisley) was rated for 9-10ths pressure. He did not know the quality of Edinburgh gas, and had only assumed it was of 27-candle power. It might have been very much higher than he had indicated. As to the cost of the burner, he was not at that moment prepared to say what it would be; because this was the first instrument that had been made, and it had been constructed very hurriedly. When it was ready for sending out, it would be supplied at the least possible cost.

The PRESIDENT said the thanks of the meeting were due to Mr. Hislop for the excellent paper he had brought before them. As Mr. Peebles had remarked, Mr. Hislop never submitted anything to the Association but what was of great use; and he was sure they all agreed with him that the present paper was of considerable service. It must have caused Mr. Hislop great trouble; and they could not do less than accord him a hearty vote of thanks for the admirable paper he had read.

Mr. HISLOP, in response, said he wished to acknowledge his indebtedness to Messrs. James Milne and Sons for the assistance he had obtained from them in preparing the instrument.

Mr. JOHN WEST (Manchester) next submitted the following paper. He merely read extracts therefrom:—

LABOUR-SAVING APPLIANCES FOR GAS-WORKS.

Gentlemen,—My first duty is to thank you for the honour your Council has conferred upon me by inviting me to read a paper before this Association upon the adaptability of machinery for various sized gas-works. I believe this invitation was the outcome of a visit of inspection made by your Committee of Investigation to the Aberdeen Gas-Works, where my cannel breakers and the rope-power system of charging and drawing machinery have been in satisfactory operation for about eight months. The vital importance of this subject is being acknowledged by the great majority of engineers. All modern gas-works are being arranged for the introduction of machinery for carrying on the various operations, with a view to economy of labour; and inasmuch as the subject I am dealing with embraces that department in a gas manufactory in which the greatest number of men are employed at the highest rate of pay, on account of the arduous nature of the work, it has received the attention of gas engineers from the earliest years of the industry.

It may be interesting for you to know that my first experiments in machine stoking were made with a retort open at both ends; the mouthpiece at one end being sufficiently long to hold a charger, which was supplied with coal from a hopper fixed on the top of the mouthpieces—the charger-rod passing through a stuffing-box in the mouthpiece lid. The front end of the charger was provided with a moveable plate, which performed the service of pushing the coke forward into the chamber at the far end; the coal being deposited while the charger wa being withdrawn. The results of the preliminary experiments induced me in the year 1873 to take out a patent for this method of stoking; but after a lengthened experience, when working on a practical scale, and a careful testing and consideration of its advantages and disadvantages, I came to the conclusion that the results obtained would not warrant an extension of the system.[*] The advantages of mechanism for distributing the coal in the retort and pushing out the coke were, however, so apparent that I turned my attention to securing them by avoiding the drawbacks of my first methods.

I then decided to put up a bench of short retorts in the ordinary way, except that I had a mouthpiece at each end; the one at the farther end of the retort being for the removal of the coke. Then I devised a travelling trolly running upon rails in front of the retorts; and within the framework of the trolly was contained a hopper for carrying the coal, as also the charger for pushing out the coke and distributing an even layer of coal in the retort. This scheme, after a long experience of its working, appeared a success. As far as the mechanical arrangements were concerned, it undoubtedly was so, and several of my engineering friends advised me to erect larger retorts upon a more extended scale. In consequence of this advice, I had erected two beds of seven ⌓ retorts, each 21 in. by 15 in. by 11 ft. long; and to ensure the perfect arrangement of these settings, a London engineer kindly lent me his foreman and another retort-setter to erect them. Attached to these beds were a separate condenser, exhauster, purifier, meter, and gasholder, with the most modern apparatus for testing purposes.

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[*] An illustrated description of the arrangement here referred to appeared in the *Journal of Gas Lighting* for April 17, 1889 (pp. 692-3).

In addition to a new travelling trolly with a combined charging and discharging machine, I now used for the first time coal breaking and elevating machinery to supply the charging apparatus. The machinery worked in a most satisfactory manner; but to our surprise we could not get the retorts hot enough to burn off as much coal as we anticipated and had a right to expect. After consideration, we came to the conclusion that the setting was defective, and we tried to improve it. But we still failed to get sufficient heat; so we pulled out the retorts, and rebuilt them upon the same plan as other settings which were giving good results on the old system, and started to work again. To our utter astonishment, we had no better results as regards the heating of the retorts, especially for 2 feet from the outlet end. I pointed this out to many of my friends, but they could only suggest again that the retort-setters must be at fault. From further observations I was induced to believe that I had discovered the cause. I therefore decided to block up the retorts with 14 inches of brickwork; and I was very glad to find that my surmises were correct. In a few hours the increase of heat became pronounced; and in the course of a few days I obtained excellent returns, and commenced to get better results than I had ever been able to produce, or had heard of, as regards make per ton, illuminating power, and saving in labour. This I attributed to retaining in the setting the heat previously sacrificed or lost by radiation through the additional mouthpiece for the exit of the coke (to which I shall refer later on), to the breaking and elevating of the coal, and the even distribution thereof in the retort. I had also diminished the arduous labour of the stoker, prevented the necessity of his working so close to the retort, and provided him with a screen from the fierce heat; leaving him nothing to do but simply turn a handle to fill the charger, then run it in, turn the scoops over, and withdraw it from the retorts. This, gentlemen, is how my manual machinery was first brought out. The increase in volume and illuminating power, with the economy that resulted in its working, realized my utmost expectations; and the fact of its being so simple, with few working parts, and consequently very little wear and tear, has no doubt been the cause of its great success.

Upon the results of experiments made by the late Mr. F. W.

Hartley and others, the Maidstone Gas Company decided to apply the system to their works as fast as the old ovens were worn out. Their lead was soon followed by Richmond, Portsmouth, Ipswich, and others; and at the present time we have supplied 21 gas-works with manual machinery (this is exclusive of those supplied with power machinery) having had duplicate orders from four, triplicate orders from two, and quadruplicate orders from one of the above gas-works.

Before going into the question of cost and saving, allow me to give you a short description of the apparatus as it now is. I found that, in order to make the machinery work successfully, it was necessary to have the coal of uniform size, and conveyed from the coal-stores into the charging scoop at a minimum cost. To accomplish this, I designed a coal-breaker, elevator, and conveyors to carry the broken coal into the retort-house; and I provided fixed store hoppers in such a position that the machines travelled under them. By having an adjustable hopper in the charging-machine, capable of carrying sufficient coal for a dozen or more charges, with a frame attached for carrying the charger, the item for coal trimming and coal wheeling was reduced to an exceedingly low figure. It is an advantage, in designing new retort-houses, to erect coal-stores on each side of the retort-house; and, if possible, provision should be made for an overhead railway running through them, so that the coal can be tipped direct from the truck into the coal breaker by opening the doors at the sides or bottom, or by lifting the waggon up by the buffers at one end, and letting the coal run out at the other, as in the case of the Oldham arrangement. Mr. E. Baker, of Reading, designed a somewhat similar arrangement for his retort-house in connection with my machinery.

The position of the coal-stores in relation to the retort-house in works already erected, is no bar whatever to the application of machinery, for the comparative saving in labour is greater in those works where the stores are separated and at a distance from the retort-house, by using a system of conveyors, as illustrated in the case of Folkestone, Belfast, Cheltenham, Sheffield, Birmingham, &c.; thus dispensing altogether with the serious item of coal wheeling. Indeed, it is in this direction that a great portion of the saving is effected—a fact which I recognized when first attempting to deal with the question of labour-saving appliances in the retort-house.

This machinery has been found most suitable for small and moderate-sized retort-houses, and is known as the manual charging and drawing machines. These machines have, I believe, been brought to a state as near perfection as they can be, if we may judge from the fact that they have undergone very little alteration during the past few years, and have given universal satisfaction wherever they have been installed. As is well known, they depend more on the strength of the stoker than do the other classes of machinery; but the skill required to work them is even less than with the power machines, as there are only a few simple movements to be made, and less mechanism to look after. The charger I use with these machines deposits in the retort the most perfect layer of coals that it is possible to imagine, and renders bad charging by unskilled men quite out of the range of possibility. Indeed, an expert man is far more likely to charge badly than a novice, because he learns tricks to save time by not letting the charger run its full course, or by turning the scoops over before the proper time. The saving in the cost of labour by these manual machines is such as to justify me in urging their universal adoption in all gas-works where there are not sufficient retorts to employ economically the more costly power machines. I scarcely think it necessary to describe the methods of operation of these machines, as the models and photographs before you will illustrate them better than pages of description.

The next step in the development of the present power machine was the addition of the necessary parts for working the manual machine by compressed air. The machines first made were but little different to the manual kind; but additiona. strength was found necessary, and was added, step by step, as the power was increased, until the compressed air machines differ but little from those driven by other powers. The transmission of power by compressed air has many excellencies to recommend it. The first machinery of this kind was erected at the Rochdale Road works of the Manchester Corporation in 1881, and is still doing good work on a large number of retorts. The compressed air is delivered to the machines from a fixed hose-reel by flexible hose. Many sets of this kind of machinery are working—including Manchester, South Metropolitan (Old Kent Road), Crystal Palace, Whitwood, and Sydney (N.S.W.); and compressed air plants of a still more advanced form are working at Birmingham, Beckton, and Belfast. In the latter kind of machines the charging is done by a long scoop similar to that in use on the rope-driven machines, which does not rest upon any part of the retort, and delivers a larger quantity of coals than can be done by the charger of the manual type. These long scoops necessitated a longer hopper to feed them, and more power to work them; and the additional weight to be propelled overpowered the hand method in use until then, and rendered it imperative to add mechanical means.

The first two sets of the rope-driven machines were erected, according to the instructions of Mr. S. R. Ogden, for the Blackburn Corporation. The house is on the ground floor, with large coal-stores on each side under the same roof as the retort-house, but separated from the working space by columns supporting the roof. There are 34 benches of retorts, making 340 mouthpieces; and the retorts are not throughs. The mouthpieces are of the same section as the retorts, and are 20 in. by 15 in. ⌓. One drawing-machine and one charging-machine on each side of the house work the whole of these retorts, with the exception of a bed at either end, which is too near the wall to allow the machines to work. The coal is delivered to four coal breakers—two on each side of the house—by carts; and the coke is drawn out of the retorts directly into barrows placed in front of the drawing-machine, and between it and the retort-stack. A small steam-engine is placed in a room built off one corner of the coal-store; and a line of shafting is fixed at right angles to the stack, with rope pulleys for driving the rope. The latter extends the whole length of the house, without any support for the bottom or driving strand, except the machines, which may be anywhere between the two ends.

Another example of the rope-driven system is that now working at the Beckton station of The Gaslight and Coke Company, where it is erected in the No. 12 retort-house, in which there are 45 beds of nine through ⌓ retorts, of 20 in. by 13 in. section, or a total of 810 mouthpieces. The house is of the standard Beckton type, with stage-floor and generator furnaces. The coal-stores are at either side, and are separated from the house by the roof columns only; the coal being brought in by an overhead railway on each side, and the coke falling from the retorts to the basement, from which it is removed in railway trucks. There are six charging and six drawing machines provided, two of each being kept as duplicates and in reserve in case of fogs, or any other exceptional demand for gas requiring four-hour charges to be put in to meet it. The engines for driving the ropes are fixed at one end of the retort-house, under the stokers' lobby; and two are provided—one being always out of action. Between the engines, and on the same centres as the respective crank-shafts, there lies a length of shafting with clutches at each end, by which either engine can be coupled up to the work. On this length of shafting are fixed the six pulleys for driving six sets of overhead countershafting by belts. Each set of countershafts, of which there are three on each side of the stack, drives the rope which communicates power to one pair of machines, and stretches the whole length of the house, with two or more intermediate supports, according to the position of the various machines. Each pair of machines—one drawing and one charging machine forming a pair—is kept quite separate and distinct from the remainder of the plant; and any pair can be left out of action or put into action at will. Either pair can work in any position on the one side of the house, and draw any of the retorts. The coal is dealt with by four coal-breakers (with elevators and hoppers) on each side of the house; and when loaded from the ship into waggons on the pier, it needs no further handling until the coke is shovelled into the trucks which remove it from the basement of the retort-house. The loaded coal-trucks pass over the coal-breakers in the coal-store, and deposit the coal on the breaker. It is then elevated into the storeage hoppers, passes from thence into the charging-machine, and is delivered into the retort. When it is carbonized, the coke is drawn out, and falls into the basement direct—no handling whatever being required.

Three of the most recent examples of this class of machinery are those in operation at the South Metropolitan Gas-Works at East Greenwich, at the Melbourne Gas-Works, and at the Aberdeen Corporation Gas-Works—the latter in a retort-house 369 feet long, containing 16 double settings of eight ⌓ retorts, with regenerator furnaces, as also about 12 double settings with ordinary furnaces. The Aberdeen machinery is practically a reproduction of that in operation at Blackburn and Beckton, with the exception of the coal-breakers. These we had to make specially large and strong to deal with the great and exceedingly tough lumps of the hardest of Scotch cannel. Upon trial of the first of them, we found we had arranged to break the coal in rather smaller pieces than Mr. Smith desired; so we had to alter the pitch of the claws in the whole of them—a circumstance which delayed the completion a little beyond the specified time. From a return Mr. Smith gives me of his working, I understand he is making a very substantial saving over his previous system of hand labour, although the machinery is only in partial operation; and I am in hopes of his favouring the members with a little of his experience.

I wish, however, to point out that the drawing and charging machines are made exceptionally strong—stronger than our earlier machines; for experience has taught us that, for retort-house work, where everything has to be kept going night and day, the ordinary engineers' rules are not adequate to the requirements, and it has been found necessary, in order to avoid any risk of mishaps or breakdowns, to make a large number of the parts of cast and Bessemer steel, and the bearings very long, and, in most cases, of gun-metal. This, of course, makes the machinery more expensive in first cost, but reduces the wear and tear to a minimum.

There are one or two points of vital importance in the designing of retort-houses for machinery. In the first place, let me impress upon you the necessity of having mouthpieces of the same section throughout as your retort; in fact, an increase of the section by ⅛ inch all round would be a great advantage. If the mouthpieces are at all contracted, the coke often jams hard in them; and if the drawing-machine is powerful enough to overcome the obstruction, and draw the coke out at one stroke, it throws a great strain on the mouthpiece bolts, and through them on the whole face of the setting. Therefore, in designing my drawing-machines, I have arranged that the power at disposal for drawing out the coke shall not be greatly in excess of that required under normal conditions. At one or two works—notably at Beckton and Birmingham—I have had to draw and charge by machinery retorts with contracted mouthpieces; and the experience I have had makes me speak strongly on this point. Again, the difference in section of retorts at different works, and very often at the same works and in the same house, is a great drawback to working machines economically. All the retorts in a house should be of the same section; and every retort in a tier should be at the same height from the floor. When these details are carried out, you get the best results; and by adopting, when making renewals, a section of retort to which either manual or power machinery could be equally well applied, the introduction of machinery in the future would not be accompanied by any additional expense beyond that incurred in purchasing it.

From extensive experience in the working of all kinds of settings, I am fully convinced that the best sizes of retorts for small and medium-sized works are those recommended by me when my manual machines were first introduced—viz., 21 in. by 15 in., 21 in. by 15½ in., 22 in. by 15 in., 22 in. by 16 in. ⌓ shape. These sizes will be equally suitable for working either with or without machinery. In larger gas-works, where power machines can be economically employed, a somewhat larger variation can be allowed for. Any section of retort can be charged by the power machines, but the sizes most suitable are: 21 in. by 15 in., oval; and 20 in. by 15 in., 21 in. by 15 in., 22 in. by 15 in., and 22 in. by 16 in. ⌓ shape.

The retort mouthpiece lids require special attention, as they must be arranged to close back to allow the machines to pass. The distance from the face of the retort-stack to the machines is 2 ft. 6 in.; and the lids and fittings will be required to fully clear this, both when they are open and when they are closed. Again, the hinges should be made so that the lids of the retorts are closed in the same direction as the machines have to travel when at work.

The next point to be considered is the space for the machinery to work in. Supposing a retort-house was being designed for machine stoking, I should recommend, for 20 feet through retorts, that there should be a space of at least 21 ft. 6 in. between the retort-stack and the wall or the face of the roof-columns. For power machines at each end of the house, there should be a space of 18 feet from the vertical centre of the end retort to the face of the end wall of the retort-house, to admit of the whole of the retorts being drawn and charged. For manual machines the space between the vertical centre of the end retort and the face of the end wall of the retort-house should be 11 ft. 9 in. The height of the roof should be sufficient to clear the top of the elevators. The height from the floor-line to the top of the elevators, measured at a distance of 11 feet from the face of the retort-stack, is 32 feet, at which height all roof principals and tie-rods should be clear. This dimension is supposing the retorts are arranged in three tiers. If for four or five tiers of retorts, for which the machines are sometimes arranged, the height of the elevator must be increased proportionately according to the height of the top retort from the ground-line. The most economical method of designing a retort-house of small size, to be worked by a minimum number of men and machines, is to have single retorts—say, 10 feet long—so that only one coal breaker and elevator and one set of machines would be necessary. A good example of the application of machinery to small gas-works is that designed by Mr. W. A. Valon for the Westgate and Birchington Gas Company, where the annual make of gas is about 18 millions.* If the rope system of driving the machines is adopted, I advise the driving-engine to be fixed at one end of the retort-house, and preferably in a line with the retort-stack. This engine should be in a building outside the retort-house, if convenient; but the system of rope transmission is such that the engine may be fixed in any other convenient position. At the end of the retort-house farthest from the engine, there should be room for the rope-tension gear, which is fixed beyond the end of the retort-house for a distance of 10 feet.

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* These works were fully described in the *Journal of Gas Lighting*, Vol. XLVI., p. 112.

Although I have given you these dimensions as applying to the best house for machine stoking, it is by no means impossible to apply machines to retort-houses where the working spaces available are much less than those named. A number of instances can be pointed out where they are working 20-feet retorts with a space of less than 20 feet between the stack and the wall; and if the retorts are of less length, the space required can be reduced in proportion. Sometimes where space at the end of the retort-house is unavailable, the machines are run out of the house at the ends. With regard to the height of the elevators, these have often to be arranged to go between two roof principals, and occasionally through the roof itself; or other modifications have to be made to suit the circumstances of different places.

With the view of endeavouring to meet your wishes, I have recently obtained working results, giving the cost of labour and wear and tear, from a number of engineers at works where either my manual or power machinery has been in operation several years. In some instances, where the hand and machine systems are in joint operation, I cannot get complete returns, because of the difficulty of separating the gas produced under the two systems, and the trouble of keeping separate records of weights of coal. But in these cases they inform me that they will be pleased to speak most highly of the machinery, and will be glad to give any information in their power. I think, however, that the many facts laid before you from a large number of engineers, with whom most of you are personally acquainted, testifying to the excellent results obtained by the adoption of the system, prove conclusively that the time has arrived when, if you wish to be in the first rank of progress, it will be absolutely necessary for all managers of gas-works to adopt these labour-saving appliances.

The author then gave some recent returns he had received from a few gas-works where his manual machinery is in operation. Summarizing the particulars furnished, he stated the relative difference in cost between hand labour and manual machinery to be as follows:—

	Machinery, per ton.		Hand Labour, per ton.		Saving by Machinery, per ton.	
	s.	d.	s.	d.	s.	d.
MAIDSTONE—						
Total cost of carbonization . .	1	5·75				
Add interest, wear and tear, &c.		1·50				
	1	6·25	2	9	1	2·75
TUNBRIDGE WELLS—						
Total cost of carbonization . .	1	6·97				
Add interest, wear and tear, &c.		1·50				
	1	8·47	2	9	1	0·53
RAMSGATE—						
Total cost of carbonization . .	1	6·40				
Add interest, wear and tear, &c.		1·50				
	1	7·90	2	9	1	1·10
WESTGATE—						
Total cost of carbonization . .	2	1·00				
Add interest, wear and tear, &c.		1·50				
	2	2·50	3	3	1	0·50
FOLKESTONE—						
Total cost of carbonization . .	1	8·19				
Add interest, wear and tear, &c.		1·50				
	1	9·69	3	0	1	2·31

Referring to these figures, Mr. West said: I wish to call your special attention to the wear and tear account at the above works, which only averages 0·64d. per ton of coal carbonized by manual machinery, and certainly not more than would take place upon the old system. With power machinery the wear and tear has been somewhat greater, especially where the retorts and mouthpieces were not of a suitable section for machine work. Where retorts are arranged under our directions or put up suitable for machine work, we are prepared to keep the machinery in repair for 5 per cent. per annum on the total outlay of machinery.

I also give you a quotation to be found in Mr. May's (Richmond) presidential address, in February, 1890, to the Southern District Association of Gas Engineers and Managers:—

> May we not, in our own domain of gas manufacture, look forward to the increasing use of machinery, and to its more rapid perfection, in the immediate future? Even at the present time it seems strange how comparatively few works have adopted the facilities for mechanical stoking which are in

existence. At Richmond, West's manual power machinery has been employed for some years with excellent results. The wages for carbonizing, including all charges from the coal-store to the coke-yard, are about 1·80d. per 1000 cubic feet; the interest and wear and tear of machinery come to 0·17d.; making a total of 1·97d. per 1000 cubic feet. This, so far as I have been able to learn, shows a saving of 10d. per ton of coal carbonized as compared with hand labour. The increased make, through more expeditious working and even distribution of the charges, is well worthy of consideration; the sale of 16-candle gas per ton of half Newcastle and half Yorkshire coal at Richmond during the past two years averaging 10,300 cubic feet.

Most of the above machines work off five charges in 24 hours—the charges varying from 300 to 336 lbs. per charge; so that the make per retort is very high, and hence a considerable saving in plant. Since these figures were given, I believe stokers' wages have increased in the southern district; but the same relative advantages will exist between hand and machine work.

I also append return given in my last year's paper to The Gas Institute.[*]

The author next gave some returns as to the working of his compressed air and rope-power machinery; the relative difference in cost between hand labour and the machinery being as follows:—

	Machinery, per ton.		Hand Labour, per ton.		Saving by Machinery, per ton.	
	s.	d.	s.	d.	s.	d.
WHITWOOD—						
(*Compressed Air Machinery.*)						
Total cost of carbonization . .	1	1·90				
Add interest, wear and tear, &c.		2·50				
	1	4·40	2	9	1	4·60
SOUTH MET.—EAST GREENWICH—						
(*Rope Power Machinery.*)						
Total cost of carbonization . .	1	1·14	2	5	1	0·86
Add interest, wear and tear, &c.		3·00				
	1	4·14				
ABERDEEN—						
(*Rope Power Machinery.*)						
Total cost of carbonization . .	1	6·44				
Add interest, wear and tear, &c.		2·50				
	1	8·94	2	7		*10·06

* These figures show a very substantial reduction for the small number of retorts (96) worked upon; and when in full operation, there will certainly be a greater saving in these works than was originally estimated for.

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[*] See *Journal of Gas Lighting* for July 1, 1890, p. 18.

Coal Breaking, Elevating, and Conveying Machinery.

As previously stated, I believe I was the first to see the necessity of applying coal breaking, elevating, and conveying machinery, both in connection with stoking machinery, and also for breaking and conveying only; and the first example I carried out was for the Folkestone Gas Company in the year 1881, under the direction of Thomas Hawksley, Esq., the Consulting Engineer. The coal at these works was delivered at one side only of the retort-house, which caused a very considerable amount of wheeling to the far end of the other side of the house. This, however, was overcome by carrying a conveyor across above the retort stack. I saw this machinery last week, and found it in very good order.

Referring to the drawings I have here, one shows an arrangement which we carried out about six years ago at Belfast, and which does its work very satisfactorily. It was for the special purpose of elevating and conveying the coal from a store in a corner of the works, a long distance from the retort-house, both for supplying coal to my stoking machinery, and for delivering coal from the hoppers into waggons for serving other portions of the works in the case of a stoppage in the coal supply. The saving in this case was very considerable, besides dispensing with the difficulty of having the men on the ground floor wheeling the coals in a portion of the yard which was already confined for space for the ordinary operations that were going on. Another is an example of the Cheltenham Gas-Works, where the stores are some distance from the retort-house, a road running between them. Very considerable saving in labour is made by the arrangement at these works. Then there is another example, at the Whitwood Chemical Works. Another drawing shows two long elevators and conveyors at the Sheffield Gas-Works, running from the railway sidings, over the yard, through a wide coke-shed, and across the retort-benches, delivering the coal direct into hoppers in connection with my power drawing and charging machinery. We have also many other examples of a similar character, as will be seen from the numerous drawings before you.

One of the latest and most perfect examples of this particular branch of breaking, elevating, conveying, and storing coal ready for use, is that which I erected at the Higginshaw works of the Oldham Corporation last year, the drawings of which are on the walls; this being absolutely the first example of the complete application of machinery driven by one engine for the purposes intended. The coal-store at the works is 220 feet long by 60 feet wide; and the railway runs along one end only. There used to be turn-tables opposite the doors of each coal-store; and from these turn-tables the railway trucks were drawn into the stores by a horse—very considerable expense being incurred in unloading and stacking the coal. Before the introduction of the machinery, from 12 to 20 men and one horse were required, according to the season; whereas three men now do the whole of the work, including the keeping up of steam in the boiler and the unloading of the waggons.

The different operations may be briefly stated as follows: The coal waggons are run over a large hopper capable of holding 10 tons, and are hoisted up at one end by an overhead crab and gearing, driven from the engine shafting, until all the coal runs out. At the bottom of this hopper is one of West's patent coal-breakers with combined engine, supplied with steam from a stationary boiler; and this breaks all the large lumps, letting the smaller coal pass through. As it does so, it falls into a pit immediately beneath the breaker, in which the lower end of an elevator works; the elevator being driven from the engine shafting. This elevates the coal through an opening in the end wall of the stores, and delivers it on to a conveyor band extending the whole length of the stores, and driven from the same shafting as the elevator. In order to deposit the coal where required in the store, a throw-off carriage is provided which can be moved to any position.

The average of a number of tests with different kinds of cannel and coal, as to the breaking, elevating, and conveying capabilities of the apparatus, is about 38 tons per hour; or if Newcastle coal were alone used, each set of apparatus would deliver into the stores 50 tons per hour, or about 2000 tons per 24 hours.

The original cost by hand labour and the present cost by machinery are as follows: *Hand Labour*—Wages and fodder, 4d. per ton. *Machinery*—Wages, wear and tear, interest, fuel, oil, and waste, 1·77d. per ton.

Other drawings here show the coal breaking and elevating arrangements in connection with inclined retorts at Rochdale, Birkenhead, and Burnley. We are now carrying out a large order for the Birmingham Corporation, at the Windsor Street works, for breaking, elevating, and conveying coals into a continuous hopper. It may also be interesting for you to know that we have received additional orders for stoking machinery worked by compressed air for the Saltley works of the Birmingham Corporation.

A very great saving can also be made in the handling of coke by machinery; and I have done a considerable amount of this class of work. There is a good example of coke stacking at Belfast, where the coke is handled by hydraulic cranes; and I learn that Mr. Hack, of Birmingham, is about to erect machinery upon a large scale for this purpose, and I have no doubt that he will soon see the advantages arising therefrom.

Inclined Retorts and the Cost of Working.

In recent times, another system of stoking has been prominently brought before gas engineers and the general public; and it therefore becomes advisable to make a comparison, not only between stoking by hand and by machinery with horizontal retorts, but also between the working of machinery with these and the new system of inclined retorts aided by machinery as well. There are several modifications of the inclined retort system, commencing with that of M. Coze, and including those of Messrs. Morris and Van Vestraut, using coal breakers, elevators, trucks, and shoots only, and that of Mr. Trewby, where a patent charging-plate is employed in addition to the breakers and elevators.*

Several gentlemen have been comparing the inclined retort system against hand labour with horizontal retorts; but their figures only represent a fragment of the cost of the retort-house work. Other gentlemen have been comparing the system against both hand labour and machinery; and in endeavouring to do this, they have shown clearly that they are not well versed in the subject of machine stoking. Before making any comparison myself as to the cost of working these various systems from the figures which have been presented to us from several sources, I feel bound to criticize the system itself; and in doing this I shall give my opinion based on absolute facts obtained from practical results and observations in connection with the carbonization of coal.

I shall first refer you to the results of my early experiments with the setting of short retorts with mouthpieces at each end. With these settings, as previously explained, the mechanical arrangements were most satisfactory; but I was reluctantly compelled to abandon the scheme, because I could not get the same results off the same space (although the fuel account was much increased) as I was then obtaining from the old system of working. Yet with the very same retorts, after the mouthpieces at one end were taken off and the retort stopped up with 14 inches of brickwork, good results were realized. These facts, gentlemen, point to the great loss of heat which took place by radiation from the retort mouthpiece and ironwork, and the effect produced on the gas inside the retort. There is no doubt whatever that the hot gases coming in contact with the mouthpieces at the end, caused a condensation of the gases, and that a quantity of the light-giving hydrocarbons were deposited in this mouthpiece and the end of the retort to which it was attached. The gas then (after being cooled) had to travel back over the hot coke to the ascension-pipe, with further injurious effect.

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* Messrs. Morris and Van Vestraut's system was described in the *Journal of Gas Lighting*, Vol. LVI., p. 74; Mr. Trewby's, in Vol. LVI., p. 251.

Now, gentlemen, I will ask you to look at the retort with which I was experimenting, and I will put this question to you: What is the difference between this and the inclined retort? Is not the only material difference the inclined position? Therefore, is not this system liable to one and all of the disadvantages attendant upon mine?—in fact, I should assume in a greater degree, because their gas has to travel downhill before it gets to the ascension-pipe. M. Coze, however, appears to have discovered from his experiments that there was a considerable loss in radiation from his shoots; for, on the authority of Mr. Van Vestraut, it has been found necessary for these iron shoots to be surrounded by brickwork. Yet in his own system he has ignored the necessity. He also points out that it is essential to this system, in order to burn off the charges, to adopt gaseous firing to ensure the equal heating of the retorts. For my own part, I am satisfied that retorts upon the inclined system could not be heated in the ordinary way of firing, and that it is absolutely necessary for them to have a large excess of heat to make anything like a return in the quantity of gas produced, which means a very extravagant waste of fuel.

It must not be forgotten that my old friend, Mr. Carpenter, of Sheerness, with whom I have been intimately connected for many years, spent a very considerable amount of time and money in trying to work out a system of inclined retorts (and I cannot see any material difference between his arrangement and that which has been recently brought to notice); and he found that, with the most careful manipulation in putting the coal into the retorts, he could not always secure very regular distribution, and that the tar deposited in the mouthpieces, and its liability to get mixed with the coke, were defects which would require to be surmounted.

I believe I have carefully read the whole of the literature which has been volunteered in reference to this system, besides having had the opportunity of seeing it in operation at various works; but, up to the present time, I have not heard of any complete experiments being made anywhere giving (1) the make of gas per ton of coal carbonized, (2) the illuminating power of the gas, (3) the fuel used, and (4) the total cost of carbonizing wages. I beg to submit that these are facts you ought to know before you can judge of the merits of the scheme; and until these particulars and the total cost of the installation of the system are ascertained, I cannot see how you can satisfactorily compare it, either against the old system of working, or against the statements which I have laid before you showing the cost of the working of machinery upon the horizontal system. I therefore venture to suggest to you that if ever there was a system that your "Committee of Investigation" should go fully into, it is this one. I do think, and I have advised, that in large undertakings a few trial settings should be erected as an experiment; and these should be thoroughly tested in every respect in the way I have indicated.

With long retorts, like those Mr. Hunt, of Birmingham, is erecting, the question of radiation may be partially overcome, in which case the question will resolve itself in large works into the relative advantages of working each system, taking the weight of coal and volume of gas produced, and all charges, from the taking of the coal from the stores to the delivery of the coke into the yard.

There appears to be very considerable doubt as to the angle at which the retorts should be erected; and various angles are suggested. The difficulty appears to me to be insurmountable when you have a large variety of coal and cannel to deal with; and it seems that it will be found necessary to have some mechanical appliance to ensure success. Of course, my own opinion is that the *right* angle from the face of the stack will still be found to be the best angle.

As to the much-talked-of benefit or comfort the workman can derive from the working of the system, I have failed to discover that he very much appreciates working on the top of the retort-benches or between them, where he is subjected to the smoke, sulphur fumes, and intense heat from the retort-settings that surround him, and which in some cases is even as high as 200° Fahr. Those of you who have not seen these men at work in these positions, ought to do so, without which you cannot fully appreciate my remarks.

[The author next quoted from the tables contained in

Mr. M'Minn's paper, read before the Incorporated Institution of Gas Engineers, and published in the *Journal of Gas Lighting* for May 19, 1891 (p. 941), showing the comparative cost of labour with the horizontal and inclined retort systems.]

It may be said that I am somewhat prejudiced on the subject. There is no reason why I should be so, as I have been favoured with a fair number of orders for breaking, elevating, and conveying machinery in connection with this inclined retort system; and I believe I have the sense to know that no words of mine will prevent the "survival of the fittest." What I strongly recommend to you, as practical engineers in charge of important undertakings, is to thoroughly test and weigh in the balance the various schemes, and adopt that which is best.

I am very gratified, after so many years of persistent working in connection with stoking machinery, to find that I do not have to rebut the criticisms and meet difficulties that I had to contend with in former days. In some cases during the good old times, when there was no competition, some managers were, I think, too much inclined to "rest and be thankful." One friend of mine indicated that he liked me and also my machinery very well, but he did not see what advantage it would be to him, as he was paying his maximum dividend, and still had a large balance to spare. I, of course, suggested that he should reduce the price of gas to the consumers. But he remarked that the public were not very grateful for what you gave them. While believing you must not expect many thanks from the public, I do hold strongly that all gas companies and corporations having the charge of a regulated monopoly have very strong obligations towards the public; and, while securing a return for their investments, they should use the best known means in their power to reduce the price of gas to the public. This feeling now seems to prevail universally amongst engineers. There appears, however, a desire in some quarters (it may possibly be for political or other motives) to keep the public from having cheap gas, by trying to prevent the introduction of all modern labour-saving appliances. To all such I would say that they will not be able to obliterate the word "Excelsior."

Discussion.

The PRESIDENT said the members had listened to a very interesting communication. As they had heard, the Research Committee had visited the Aberdeen Gas-Works with the intention of presenting a report; but, on consideration, they had thought this would not be necessary, more especially as

Mr. West had agreed to read a paper, and Mr. Smith was going to give the meeting some copious notes on the working of his machinery.

Mr. ALEX. SMITH (Aberdeen) said he thought this was the first time the Association had had before them the subject of mechanical stoking, at all events so fully as Mr. West had presented it. He wished just to say, before he gave the members the results of the working of the machinery at Aberdeen, that, in the course of his travels some time ago, he came across, in England, the machine invented by Mr. W. Foulis, of Glasgow. It was strange that he should meet with it there. So far as he could see, it was doing its work well; and it appeared to him to be an extraordinary thing that the appliance should be working in England and not in Scotland. He went over to the party in charge of the machine, examined it, and asked the man how he liked it. The man replied that the machine was "doing good and honest work." This was one of the things he (Mr. Smith) could not get over, why the machine stopped in the Glasgow Corporation Gas-Works. It seemed to show that they had not insisted enough upon it in Scotland, and that they could not hope to introduce any new thing unless they took personal supervision of it. They could not leave the introduction of new things to foremen and workmen, for they would bring forward all sorts of objections, and everything would be put in their way. He therefore resolved, when he took Mr. West's machinery on trial, that he would follow it out night and day himself, as far as he was able to do so; because he felt that, if he did not, the trial would prove a failure. They resolved to introduce four coal-breakers, two drawing-machines, and two stoking-machines. He thought he could truly say they gave Mr. West a "wrinkle" or two when he was in Aberdeen. [Mr. WEST: But it cost me something.] He did not think Mr. West ever saw a three-hour charge carried on with the heats and quantities of coal they put in there. As Mr. West was too long in erecting the plant, and they were having coal strikes and coals that were not of very good quality, he was almost obliged to have the whole of the retort-houses worked with this machinery. They took a section of 96 retorts, which were charged for three hours with 2¼ cwt. of coal. This was at the rate of about a ton per 24 hours. During the old process, they had 71 men engaged in the work. These men cost every week £86 16s.; and, with a quantity of 672 tons of coal, this came to 2s. 7d. per ton. After the new system had been adopted, the number of men was reduced to 42; and the wages then paid amounted to £51 13s. There was some advance in the rate of pay, because the old men were put on the machine, and were allowed a little more on this account. The 672 tons of coal were carbonized at the rate of about 1s. 6d. per ton. He was sorry he could not give the quantity of gas made per ton of coal. Previous to this they bought cannel coal, which produced a large amount of gas; and they used to average from 10,300 to 10,500 cubic feet per ton of a fair quality of gas. But in the last few years they had been having cheaper coal, which only yielded from 8000 to 9000 cubic feet. Therefore he did not think it would be fair to give a comparison until they had a year's work with the same kind of coal. He could put before them, however, this very important point: He had observed that, by charging the retorts with the aid of machinery, he could keep in the coals about eight or ten minutes longer than when they were put in by hand. The members must understand that this meant an increased quantity of gas. With regard to the coal breakers, they experienced little difficulty with them. They had Muirkirk coal to deal with; and it had been stated over and over again that the machines would send the cannel all to pieces, and reduce it to dross. He asked one of his men on the previous day to take up the coals as they came out of the machine; and it would scarcely be believed that there was hardly any dross. It was a matter of wonder to him that the system of charging and drawing by machinery had not come sooner to the front. He found that it was 41 years since the subject was introduced; and the idea lay dormant until Mr. West and others took it up. He believed it was a really excellent system; but, as he had said, anyone who adopted it must go into the matter with personal supervision, if it was to be a success. In conclusion, he had only to state that all the machinery had fully come up to his expectation.

Mr. W. A. **Valon** (Ramsgate) said he had been greatly interested in the paper before them. The figures he had been able to give from the Ramsgate Gas-Works had been taken out by an accountant; and, whether they were favourable or unfavourable, they were just as they appeared in the books. He thought Mr. Smith had gone into the matter so elaborately that he (Mr. Valon) need not to say very much. He had only to remark that, as a matter of fact, Mr. Smith's experience had been somewhat similar to his own. He was one of the earliest to adopt the machine, which he saw was a step in the right direction. He thought that a great point in its favour was that the wear and tear had been very small. He anticipated that for the first year it would be a great deal more than it was. With regard to the quantity of coals they could put into the retort, he wished to explain that it was only limited by the amount they could take out. He thought the coal in Scotland shrank, so that whatever they put into the retort they could get from it. The reverse was the case in England. The coals there swelled; and the result was that they could not put in so much as they otherwise would do. However, they were now able to charge more than they did before. While on this point, he wished to refer to Mr. Smith's questioning of their economy in England in allowing the coals to remain for six hours in the retorts. When they were using cannel coal, they sometimes did so; but they drew the retorts every three or four hours when they were dealing with ordinary coal. They found five or six hours the utmost limit. It depended entirely upon the quality of the coal. He saw that Mr. West had the figure 3·17d. for hand work at Ramsgate. This was less than the cost.

Mr. WEST: That is what I really want to know; I want your information.

Mr. VALON said they calculated it would cost them about 3¾d. per 1000 cubic feet, or 4½d. in small works; so that the saving by the machine would be more than was put down. He noticed that Mr. West's machinery was driven by compressed air, and also by wire rope; but he must say that, so far as he was concerned, he thought the manual machines, with the maximum of labour, were handier than either air or wire-rope machines. He was speaking a little in the dark on this matter, because he had never worked them; he was only judging from the saving he effected at Ramsgate with the manual machine compared with what was done elsewhere by using the air machine. There was another great point in favour of the manual machine—viz., that it could be adopted in the smallest works. For example, there were the works at Westgate-on-Sea, where they carbonized only 1600 tons of coal in the course of the year, and where one man did the whole of the duty. In the summer he drew the retorts and did everything. With regard to inclined retorts, he agreed with Mr. West in the opinion he had given of them. He (Mr. Valon) had visited most of the places where retorts set on this plan were worked, and he did not think there had been an advance on the position twenty years ago. He had great doubts as to the economy that would be effected in fuel; and he was sure that the cost of operating them would be a great deal more than it would be for working West's machinery. To his mind, this machinery was the "survival of the fittest." He certainly thought it was impossible to put anything like the same quantity of coal into an inclined retort, and work it, as could be placed in a horizontal retort. It was not, perhaps, fair to criticize a system which had only just been seriously worked; but he must say that what he had seen of it up to the present time had not been very satisfactory to him. He agreed that it was a reproach to gas engineers that Mr. West's machine should have been so many years in the market without having been more generally adopted. If the electric light would only drive gas managers into doing their duty in this respect, it would be something to be thankful for.

Mr. A. MacPherson (Kirkcaldy) said he was one of the deputation from the Committee of the Association who visited the Aberdeen Gas-Works to inspect Mr. West's machinery; and all he had to say about it was that they were unanimously of opinion that it was a success. It certainly did its work in a splendid manner. Mr. Smith put himself to the trouble of giving them a thorough insight into all the details; and the Committee were highly satisfied with the whole of the arrangements. They considered that Mr. Smith had done for the Corporation of Aberdeen the best thing it was possible for him to do, and that Mr. West deserved very great credit. There was only one thing he would like to ask gentlemen who had had experience with the machinery, and that was whether, in working the manual or the other systems, there was any difficulty with the carbon that would collect in the retorts, or whether it was kept down by drawing. It might be of advantage if Mr. West would tell them something on this point.

Mr. W. Key (Tradeston, Glasgow) said he would much like to make one observation as to Mr. West's machinery. He had visited the Aberdeen Gas-Works as a member of the Committee of the Association, and he must confess that he was greatly pleased with the excellence of the machinery. One feature which struck him in connection with the coal-breaking arrangement was the wonderful way in which the large coal was reduced to pieces of the size required.

Mr. D. Terrace (Middlesbrough) said there were one or two points to which he wished to refer. The first was as to what had been stated about the heats prevailing in the retorts in England, where six hours were, it was said, required for working off a charge. This was not the case with him, for he had been able to work off Newcastle coal in three hours; and if they did this in Scotland, why should they not do it in

England? In his opinion, the superior heats had nothing to do with the question at all. He did not agree with Mr. West in some of his remarks about the inclined retort system. He (Mr. Terrace) was trying this system on a small scale at Middlesbrough, and he thought it would be a pity if the statements made in the paper should go unchallenged. The right thing to do, as Mr. West admitted, was to give both systems a trial; and then experience would teach which was the best.

Mr. T. D. HALL (Montrose), as a member of the deputation to the Aberdeen Gas-Works, said the first thing that struck him was the facility with which the breaking-machine reduced the large lumps of cannel coal into small pieces. The drawing and charging machines, so far as he could see, were perfection; he thought it was all very creditable to Mr. West.

Mr. WEST, in reply, said Mr. Smith had kindly told the meeting that he had searched England through, and had decided that his (Mr. West's) machinery was the best, and that, like a thoughtful man, he would test it. He (Mr. West) was very pleased to hear once again from Mr. Smith that the machinery was acting very well, and giving satisfaction. Mr. Smith would see, as he went on, that the work would improve. He would find that there would be greater economy the more retorts he worked the machines to draw and charge. Mr. Smith had mentioned something about hydraulic machinery. Well, he did not know whether he ought to say anything about that or not, but they did work the machinery in Manchester, and it was working there now. He considered that they had improved it very much; and he thought he had given them a "wrinkle"—that it was advisable to bring the coal to the machines by mechanical means. When he was appointed Chief Engineer to the Manchester Corporation, some years ago, seeing that he was a kind of rival to the hydraulic machinery, he made up his mind that it should not suffer in his hands; and he thought he produced better results with it after he went there than had been obtained from it before. Of course, all these machines had their various merits; but he naturally had a very firm conviction that what he was advocating was the best. The question of coal breaking was, no doubt, a very important one; and he must admit that the cannel breaking at Aberdeen was a tough job. Mr. Smith sent some samples to Manchester, and they tried them. They did not get all the pieces to go in the right way of the grain; but the machinery in their works seemed to work it better than the machinery in his works did. The chief difficulty was that the coal was broken too small. There were no defects whatever in the machine; the only thing was that they were in ignorance as to the way to do it. These machines had certainly taxed his brain power beyond measure. It was not very easy to meet all sorts and conditions of things in cannel breaking. They had blocks like pieces of timber; and the idea was not to pound it up, but to crack it, so as not to make it too small. With Newcastle coal, or any other coal like that, it did not matter; and this was the sort of stuff with which he had been accustomed to deal. So that he had really had no experience of cannel until he went to Aberdeen. Although in Manchester they had 25 different kinds of coal—cannel coal being amongst it—he never came across anything like what he had to contend with in Scotland. He was very much obliged to Mr. Valon for what he had said about wages. He knew what Mr. Valon had been doing; but he thought it better to be on the right side. They had heard what Mr. Valon had said about moderate sized gas-works. This was a very important matter for them in Scotland, where they had so many small works. Mr. MacPherson had asked a question about the carbon in the retorts. He (Mr. West) did not know that using machinery made any great difference. The rake going in cut the carbon to a greater extent than was done by hand; and the scoop scraped it off the sides, and did not allow it to accumulate at the same rate as it did with hand charging. When it formed—and it always did form—every charge tended to rub it off. When the carbon came to collect in such quantities as to be positively detrimental to the working, there would be a thickness of about 1½ inches on the side of the retort; and all he could say was that when this was the case it was time it was taken off, because they had to conduct their heat through it. Mr. Terrace had spoken of Newcastle coal, which he said was used in the South. He might tell Mr. Terrace that there was a great difference of opinion about the matter he had mentioned. He for years worked off four-hour charges; and he tried to force them upon his friends in the South. But for a long time they had gone back to five-hour charges. They seemed to find that, taking everything into account—stopped ascension-pipes and everything else—it was best to put more coal into the retorts, and reduce the heats a little. The question there, however, was what was the result. They might not do the work in the same way; but if they arrived at the same result, where was the difference? He (Mr. West) thought the four-hour shift was the more preferable. Mr. Terrace had alluded to inclined retorts. Well, what he said was that the result of his experiments with these retorts was that there was a considerable loss of heat by radiation through the two mouthpieces and from the larger surface of the stack. If they could prove to him that he was wrong, he would acknowledge it. The retorts were on their trial; and he suggested to the members, as practical men, that they should make comparisons, and take everything into their calculations, before they came to a conclusion. For himself, he would not compare them. When he was asked to do so, he simply put himself into comparison with the figures which had been presented by advocates of the inclined retort system; and he said that, as a result of practical experience for many years, he could beat them in every shape and form.

Mr. Smith (Aberdeen) asked to be allowed to reply to a remark made by Mr. MacPherson. He could not say that there was very much difference in the quantity of carbon formed with hand and with machine working, with the exception of the top retorts. The men could not get up to these to take it out properly; but the machine cleaned them thoroughly, and therefore they were better than the hand-charged retorts. But, of course, they would always have carbon on the retorts.

The President said he did not think any remarks he could make would add to what the members had heard in the interesting discussion which had taken place; and therefore he would confine himself to moving that they accord to Mr. West their very hearty thanks for his paper.

The proposition was cordially agreed to.

Visit to the Edinburgh Gas-Works.

The meeting then adjourned for luncheon. During the interval, most of those present walked to the Edinburgh Corporation Gas-Works. There they were cordially received by Mr. Kinloch Anderson, as Convener of a Sub-Committee appointed to receive the Association, who was accompanied by other members. Mr. R. Mitchell, the Engineer, and Mr. Jack, S.S.C., the Clerk to the Edinburgh and Leith Gas Commissioners, were also in attendance to receive the visitors.

Mr. Anderson said that, on behalf of the Edinburgh and Leith Gas Commissioners, he gave the Association a very hearty welcome to visit the works. Being all practical men, they would know a great deal more than any of the Commissioners as to what they saw in the works. They could all look at them, and suggest anything which they thought would be an improvement. He was sure that all their employers, wherever they came from, must have been disappointed at the necessity of raising the price of gas. There had been a very general grumble in Edinburgh—first as to the reduction in the quality, and then as to the raising of the price; but both were inevitable. They, however, as Commissioners, were desirous of giving the consumers as good a light as possible, and were determined also to keep the price as moderate as they could, both of which they hoped to be able to accomplish through the excellent management of their Engineer, Mr. Mitchell.

The President thanked the Councillors and Commissioners for the handsome way in which they had received the members. This was, he said, the first time the Association had met in Edinburgh since the Corporation had acquired the gas undertakings; and he thought it was a very fitting thing that the gas managers should visit them, and wish them success in their work. He proposed a vote of thanks to the Commissioners for the kind reception they had given to the Association.

Refreshments were then served in the governor-room, after which the party were conducted over the works by Mr. Mitchell. The chief item of interest was the magnificent new bench of retorts, numbering 480, on the back-to-back system, which had been recently built. The retorts were ⌓-shaped, 21 in. by 15 in., and 9 ft. long; and the bench was fired on an adaptation of the Siemens principle. The other recent improvements, such as the overhead railway, also came in for a good deal of attention; and the opinion was generally expressed that the works were in a very compact condition, well arranged, and in the best order.

Election of Office-Bearers.

On resuming the business after luncheon,

The Secretary read the report of the Scrutineers on the ballot for the election of office-bearers, which showed the following result:

President—Adam MacPherson, Kirkcaldy.

Vice-Presidents—T. D. Hall, Montrose; W. Key, Tradeston, Glasgow.

Secretary and Treasurer—Robert S. Carlow, Arbroath.

Committee—James M'Gilchrist, Dumbarton; Levi Monk, Maryhill; and Alexander Smith, Aberdeen.

Place of Next Meeting.

The ballot was in favour of Dundee being the next place of meeting.

The President reminded the members that they proposed to unveil the Murdoch bust in the Wallace Monument next year;

and he suggested that they should meet in Stirling, as being, on that account, a more suitable place.

After a somewhat warm protest by Mr. John M'Crae, it was agreed that the meeting should be held in Dundee; the suggestion being thrown out that the members could, on the second day, visit Stirling for the purpose of unveiling the bust.

THE REMAINING PAPERS.

Mr. G. LOVE (Paisley) then read the following paper:—

THE CONSTRUCTION AND WORKING OF REGENERATIVE RETORT SETTINGS.

On being asked by your President to contribute a paper at this meeting, and considering the various subjects upon which to write, I very naturally resolved to give one on a matter to which I have given considerable attention—viz., the construction and working of regenerative retort-settings. On looking over the annual reports of this Association, I find that for the past eight years this question has occupied your attention to a considerable extent; and papers of very great merit have been written on it, by gentlemen well qualified to speak on the subject. Their complete description of the Siemens, Klönne, and other systems, presently at work in our midst, will limit my paper (unless I go over old ground) to a description of the construction and working of the regenerative system at the Paisley Gas-Works.*

The first construction, on a large scale, of Mr. G. R. Hislop's method of regenerative firing was in the Spring of 1888, previous to this we had several ovens of four retorts at work for a couple of years, the thorough success of which led to a larger construction on the same principle. In one of our retort-houses we had two benches of 40 retorts each, working back to back; the chimney being placed between them. These were at work on the open system of firing—two retorts in each oven, with ten ovens on either side; making in all 40 retorts, with 20 fires, per bench. This method of setting was due to the inferior quality of the coke used. In order to give the new system a fair trial, it was resolved to take down one bench. In this space we found that eight ovens (four on each side), of eight retorts per oven, could be built—making in all 64 retorts —as compared with only 40 retorts formerly occupying the same space; thus effecting a saving of 66 per cent. of retort-house area. The ovens were 8 ft. 6 in. wide by 9 ft. high to the inside of the crown of the arch from the floor-line; while to get the proper depth of producer and travel for the regenerators, we had to excavate 5 ft. 10½ in. to the bottom of the foundations. In making these excavations, we had to go 3 feet lower than the foundations of the retort-house gable wall; necessitating the underbuilding of it to this extent. This was successfully accomplished—building widths of 3 feet at a time, putting in wedges well driven up, and, after completion, making a thoroughly safe and substantial job. We have two main flues—one for each side of the bench; and these are started on the top of concrete foundations, with a 14-inch wall between them. Each oven has four outlet ports to the main flue, and is so built as, if necessary, to be easily cleaned through into the main flue from the front of the bench. Formerly our main flue was on the top of the bench, having uptake flues in the centre wall of the oven. But by placing the main flue underneath, there is less liability to fracture, no loss of heat by radiation takes place, there are no uptake flues, access is easier for cleaning purposes, and there is a saving in solid brickwork.

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* An illustrated description of Mr. Hislop's arrangement of regenerative retort-settings, as supplied to small works, appeared in the course of the report of the 1888 meeting of the North of Ireland Gas Managers' Association (see "Reports of Gas Associations" for 1888, p. 231). The original patented arrangement was described in the *Journal of Gas Lighting* for Dec. 9, 1884, p. 1045.

The producer and the regenerators are built inside the ovens, and are so constructed as to be taken down separately, if necessary, for repairs, without damage to the other parts. The regenerators are placed on either side of the producer, and are formed of two backing-up tiles—one against the wall of the oven, and the other against the wall of the producer—with vertical division-tiles dividing or separating the two flues; the whole space being spanned by one tile. This, however, was found objectionable, as not being easily jointed; and two cheeked tiles were substituted. The secondary air is admitted near the bottom of the sunk chamber, by means of an air-tight sliding disc arrangement; the air travelling backwards and forwards five times the full length of the oven—altogether about 30 feet of travel—before enfering the combustion chamber. The waste gases from the oven pass down in the opposite direction to the secondary air, and have on the same level as the admission port of the secondary air a down-going port with dampers placed one on either side of the oven, for controlling the draught. Immediately underneath this damper there is an escape port to the chimney; but this port is controlled so that a large proportion of the gases flow down and along underneath water-pans, for the purpose of generating steam—thus saving the supply of steam from a boiler outside, and at the same time more fully abstracting the heat from the waste gases. These pans are made of cast iron, and have a protecting tile underneath. From the side of the regenerators, and passing over the pan, is thrown a curved plate of cast iron, having on the top boxes forming ports for the admission of air and steam to the producer. Inside these plates is the pan chamber. The outside or top of this plate is covered with the side arch brick, forming the sides of the bottom of the producer; and separating these two plates at the bottom is placed a cast-iron sole-plate 6½ inches broad. You will thus observe the absence of any moveable parts in the furnace. In the front wall of the oven at the pan chambers, and on a level with the top of the pan, are built cast-iron frames fitted with air-tight doors; being faced all over, and having a moveable disc arrangement for the admission of air for the supply of the producer. On top of this frame, ½-inch malleable iron tubing is led, for the constant supply of water to the pans.

The sides of the producer are started on top of the curved plates, over which an arch is thrown, with ports through the crown of the arch into the combustion chamber on the top. Between the two bottom retorts, and on the top of the producer, is placed the combustion chamber, the top of which was made a continuous arch, with outlet-ports for the gases to the oven; the crown forming the bed for the centre retorts. In the front wall of the producer are built two doorways. The top one is formed above the floor-line, and used for charging the producer; this process being accomplished by hand. The under one, which is near the bottom of the producer, is to allow of the latter being cleaned out. Covering all is a cast-iron front plate, bolted to which are cast-iron mouths fitted with air-tight doors, having bridles, screws, &c. By this means the producer is kept perfectly air-tight. Spy-blocks are placed in ports carried through the front wall into all the secondary air and waste gas flues. By this means every part is easily got at, and can be cleaned out when necessary. For facility of access to the cleaning-door, to the pan chambers, and also to the regenerators, a sunk chamber is formed, 8 ft. 10½ in. long, from the front of the bench, the same width as the oven, 8 ft. 6 in. by 4 ft. deep; brick steps being built in the back wall for the purpose of getting down and up. The sides of each sunk chamber are formed by the extension of the division walls of the ovens to the back wall of the sunk chamber. These form a rest for the bench-binders, and also at the same time save heavy cross-ties, which otherwise would be necessary to withstand the outward thrust of the bench; thus keeping the entire bottom of the walls thoroughly solid and safe.

The bench-binders, which are formed of two heavy malleable iron plates placed 10 inches apart, and bolted together through distance studs, are let down 2 feet under the surface of the division walls of the sunk chamber; and bolted to the binders near the floor-line is a thin malleable iron pocket, set into a chamber for the purpose of carrying air down into the sunk chamber for the necessary supply of secondary and primary air to the ovens. The sunk chamber is covered at the sides by cast-iron chequered plates being carried by the walls and T-iron bars, while in the centre are two hinged doors and a moveable plate for the purpose of getting underneath; the whole making a very strong and substantial, and at the same time a comparatively cheap, job. The retorts are supported upon six piers 9 inches broad, carried up to the centre of the top retorts, having 9-inch spaces between each pier. These piers are formed of special blocks, each made to suit the position on the side of the retorts; thus very much simplifying the building. The blocks, as well as the whole of the brickwork from the top of the producer upwards, have a great percentage of silica in their composition, so as to thoroughly withstand the heat.

The furnaces were first lighted for drying the ovens; and a gradually increasing fire was kept on till this was done. We then commenced firing with four-hour charges (these being light). But after a few days' working, these were increased to three-hour ones; and very fair heats were obtained. The coke from the two bottom retorts was drawn into low bogies, and charged by hand into the producers; this being found sufficient to maintain the necessary heats. The coke from the other six retorts was drawn into barrows, and taken out of the house to be slaked. The furnaces were cleaned out every twelve hours at this time. In the case of most of the furnaces, we were not very much troubled with clinker, although they were not what we desired. This was owing to the flues under the pans being too narrow, and also to the pans being allowed to run dry. We had also some little difficulty in regulating the primary and secondary air supply, as well as the extent of dampers; but these troubles were due to the men slaking the coke before charging the producers. They did this because it was not very easy to throw red-hot coke into the producer. The consequence was the heats fell considerably after a fresh charge of fuel —showing very decidedly the necessity of charging with red-hot fuel, in order to secure the minimum production of carbonic acid at the outlets of the producer. We experienced some trouble also with the combustion chamber, having at this time only one for each oven. The heat being too much confined, owing to the smallness of the parts, &c., the brickwork melted, and formed large stalactites on the crown of the arch. A portion of it falling in necessitated the putting out of the furnaces, and the repairing of the chamber. Bricks containing 90 per cent. of silica having been procured, the damage was easily rectified (all parts of the work being readily accessible without injury to other parts). The retorts were then re-lit, and were kept going all the winter, to our complete satisfaction.

The great saving effected by this bench, as compared with the old system warranted the erection of more; and it was resolved to put up two other benches, containing 64 retorts each—making in all 192 retorts on the regenerative principle. Profiting by the previous winter's experience, several very important improvements were effected, as follows: (1) The arch of the producer was improved, and uptake ports were placed on either side, instead of one row in the centre, as formerly. (2) The secondary air ports were brought in on the bed of the combustion chamber, instead of through its sides. (3) We had two combustion chambers instead of one, with a solid 9-inch wall running the full length of the oven, between them; and we also did away with the arch (the top of the chamber being open), but the placing of a protecting tile under the bottom of the centre retort was necessary. (4) The piers for staying the retorts were made 6 inches instead of 9 inches broad, as formerly. (5) The introduction of a patent shoot arrangement, whereby the red-hot coke is drawn from the two centre retorts directly into the producer. This shoot, when working, is at such an angle that the coke is regularly placed throughout the entire furnace. It is a fixture to the bench, and of simple construction, while all parts are maintained air-tight. When inoperative, it folds back out of the way, and presents a very complete and satisfactory method of filling the producer. With these exceptions, the ovens are built in accordance with the description already given.

These improvements had the desired effect; producing results even better than were expected. The heats maintained in the retorts are very great. There is no hemming-in of the heat at any part; but combustion takes place nearly throughout the entire length of the setting. The two centre retorts, being a little hotter than the others, are each charged with 1 ton 2 cwt. of coal, while the side ones have only 1 ton each per 24 hours—all three-hour charges. Each oven carbonizes altogether 8 tons 4 cwt. of coal per 24 hours; giving a yield of 9908 cubic feet per mouthpiece per day, or 9667 feet per ton of coal. The quantity of coke used in the producer is 26 cwt. per 24 hours; or, as it is usually stated, 15 lbs. of coke per 100 lbs. of coal carbonized—the coke used containing 7½ per cent. of ash. For comparison with results in English coal—say, with 3 per cent. of ash—the fuel would be 10½ lbs. per 100 lbs. of coal carbonized. The producers were cleaned out every 36 hours; but latterly we have been doing this every 24 hours—no trouble whatever being found from clinker. We attribute this to the method of introducing the steam, and to the shape of the patent producer; the steam making the clinker soft and friable, and keeping the lower portion of the producer cool, while the shape causes the coke to be held up in the form of an arch by the hot film of clinker, while the softer ash is being drawn out at the bottom through the cleaning-door by means of a rake. Thus the great rush of cold air into the oven is obviated while the furnace is being cleaned; and besides this no dust can get into the setting, as both air and dust are trapped by having to pass through the mass of red-hot fuel suspended in the producer, as already described. We found that the quality of coke used for firing purposes is of some importance—splint making the best coke; although until lately we used a mixture of splint and second-class cannel, and found no difficulty with clinker.

The advantages of this system over the former methods of working are higher heats, and these maintained (not fluctuating, as formerly), and consequently a larger production of gas. This is shown by the increase last year of 272 cubic feet per ton, as compared with the results on the old plan; and this, too, with an inferior class of coals. In making a comparison, attention must be given to the quality of the coals used. This increased make is from a mixture of about one-half splints, one-fourth shales, and the remainder second and third class cannels; and this for gas of 27-candle power. The life of the retort is also prolonged. We are this year renewing the same number of retorts, after a make of 254 million cubic feet, as we did when our make was 190 millions; and this notwithstanding the fact that by having three-hour charges we get one-fourth more work out of the retorts than we did then. The saving in labour is 3·46d. per ton of coal carbonized. The retort men are much better pleased to work with the new than with the old system;

and well they might be, as their labour is less, and not so trying as before. The saving in fuel is very considerable.

The cost of the first bench erected, exclusive of hydraulic mains, connections, and 40 bridge-pipes, was £1140 5s.; being £17 16s. 4d. per retort. The cost of the next two benches (128 retorts) was £2445 1s. 8d.; being £19 2s. 0½d. per retort, or an increase of £41 5s. per bench. This was owing to the rise in the price of ironwork. The total cost of the three benches of 192 retorts was £3585 6s. 8d.; being at the rate of £18 13s. 11d. per retort. This sum included all material and workmanship, except the hydraulic mains and connections, and 120 bridge and dip pipes; and it was also exclusive of royalty. The saving in coke and workmen's wages alone paid for this extension in fifteen months; and had the prices obtained formerly for coke been maintained, the actual expenditure would have been met in twelve months. The economy effected in these two items for the past year, as compared with the old plan, has been 2s. 8½d. per ton of coal carbonized. I ought to mention here that, previous to the adoption of this system, the whole of the retorts were in use during the winter; and we could not further extend our benches, as all the retort-house space was used up. By the introduction of the plan I have described, with its saving of 66 per cent. of retort-house area, we have been enabled to avoid for at least three or four years, the expenditure of a large sum for a new retort-house; and I think we are at least entitled to put to the credit of this system 5 per cent. for the sum necessary for such an extension.

In order to ascertain the condition of temperature to which our retorts were subjected, and to what extent the heat was abstracted from the waste gases before entering the chimney, I inserted a pyrometer into the main flue near the chimney, and found the temperature to be 600° Fahr. Testing it back to the interior of the oven through the various flues, it gradually rose till, on reaching the combustion chamber, the outer shell of the instrument, which was made of cast iron, melted after being inserted for five minutes; the metal running along the bed of the chamber like water. We were enabled, however, to make out the temperature to be about 2700° Fahr.; and this was pretty equal over the oven. The secondary air is heated to 1700° Fahr. before coming into contact with the producer gases; thus clearly showing a slow and thorough action of the regenerators.

This system is applicable to settings of from two up to eight retorts, and it has been adopted in various places in Scotland, and also in England, Ireland, and America, in all of which it is giving very high results and general satisfaction. The cost of erection varies very much in different localities, and also according to the number of retorts in each oven. In an oven of six retorts, the extra expense, as compared with the old system (including royalty), is £60. But when we consider the fact that we get one-fourth more gas per mouthpiece per 24 hours, and an increased yield per ton of coal through higher and more regular heats, it will be found that, instead of an excess, it is just the reverse, being really a saving on the old system, and this entirely independent of the large economy effected in fuel, wages, and retort-house area.

Discussion.

Mr. J. West (Manchester), on the invitation of the President, opened the discussion. He said he was hardly prepared to do so; but it was a matter in which he was certainly very much interested. The paper threw some light on the subject; and the results were very good indeed. He should like to ask the writer two or three questions; and first of all as to what kind of material he used. Was it cannel, or a mixture of coal and cannel? because he was not quite *au fait* as to what was done in Scotland; and he should like to have particulars on this point. As regarded regenerative furnaces, he thought that the question was pretty well settled. He was a great advocate of the system himself; and in its early stages he carried out some very extensive experiments thereon in Manchester. They did the same as their friends had done. They worked them, but really did not know how to manipulate or to regulate them. They found that it was very necessary, if they wished to succeed with these furnaces, that they should have the very best material they could get; and some of the Scotch material, such as the Glenboig, certainly turned out better than that which they could get in England. He was glad to see that they had presented to them an inside producer. It was probable that in Scotland there were many advantages in using an outside producer; but in England they did not appreciate them very much, perhaps because their coals were of a different sort—there being less ash in them. The inside producer certainly appeared to him to be far superior to the outside one, because with the latter they must lose a quantity of heat by radiation, whereas with the former they had mostly all the heat expended inside. Several things suggested themselves to him. The first was the shoot that conveyed some of the coke into the furnaces. He did not know the object of the door below that shoot. In England they had only one place in which to drop the coke, and another below for drawing the clinker out. He saw that, in the furnace described, the producer was directly under the retorts; but in England, and especially in some furnaces with which he had experimented on a very large scale in Manchester, they came to the conclusion that it was better to have the producer brought out a little in the front. By this means they could drop the coke straight into the producer—it required no pushing back in any way; and there was a saving of fuel, with less work for the stokers. Another thing he did not understand was why there should be two exit flues. There might be an advantage in this; but they had not found it to be so in England. He had not tried the arching in the inside of the oven, as shown; but he supposed he might conclude that there was something to recommend it. The arrangement for evaporating the water was doubtless advantageous. They used pans; but when they had ash in them they did not get sufficient steam. At Nottingham they had introduced in connection with the flue a little boiler for generating steam, because they wanted more steam than they could evaporate underneath the bars. In all probability the plan shown would meet the case. The arrangement of the flues was very similar to his own. It appeared to him the cost was very low; but he did not quite understand whether or not the figures given were for the setting without the cost of materials.

Mr. T. D. **Hall** (Montrose) said he could not add anything to the discussion, so far as experience was concerned; but a remark made by Mr. Love had struck him. He said they had been in the habit of using splint coal, and that it answered very well. Numbers of them had not had any experience with regenerative furnaces, but they all knew what coke was; and although he found the coke of splint coal very good—better, he might say, than the coke from English coal—the addition of a little cannel rather improved than deteriorated the quality of the coke. He mentioned, for Mr. West's information, that in Scotland they had some cannel coal which produced very good coke. During the railway strike, he had occasion to introduce some Newcastle coal; and he had great difficulty in keeping their fires going with it alone. But having put in some Scotch cannel, the clinker disappeared. They had no regenerative furnaces. But they had air flues; and he could not say they had found any difference between the old furnaces and those with the flues.

Mr. J. **Hepworth** (Carlisle), on being invited by the President to take part in the discussion, said he had come to the meeting as a learner rather than in any other capacity. He might say, however, that he was much struck with the facts Mr. Love had given—too rapidly, he acknowledged, for his comprehension—one after another. One that had interested him most was as to the cost, to which Mr. West had referred. He (Mr. Hepworth) had had regenerative furnaces at work, and he advised everybody to have them. He did not, however, know anyone who had had such as those described; but if the results stated could be attained, it was a very important thing. He would not discuss the question of the setting they had before them with reference to the producer. If, however, Mr. Love had had any experience with settings such as those he showed, with two or three retorts in an oven, and could tell the meeting something about the results, when the brickwork did not go so low down into the ground as in the larger ones, he should be very glad to know the relative advantages that would be obtained with a setting of this sort as compared with a setting of eights. Another thing which struck him was that, where they had the main flue upon the setting, they might sometimes take advantage of it in order to obtain heat from it in some way. He had not at present a setting of this kind, except in one bench. He did not see why they could not insert, in or near to this flue, a pipe that would convey air to the outside, and be delivered at the point required over their coke furnaces. Probably Mr. Love and Mr. Hislop would have had some experience in this direction. If they had, he (Mr. Hepworth) would very much like to know from them whether there was any possibility of getting assistance of this sort in a cheap way. He assured the members that he was much pleased to be present at the meeting, and had been extremely interested in the papers read.

Mr. J. M'Crae (Dundee) said he had studied Mr. Hislop's furnaces very carefully, and thought they were the correct thing, especially for small gas-works. He would not, however, say they were the best for large ones. He had several on hand just now. Judging from the reports he had received from those who had had experience with them, the economy was very decided; in fact, the amount of saving seemed to him to be very great indeed. He had recommended them in several cases where ten or twelve retorts were required; and they had turned out satisfactorily.

Mr. A. Smith (Aberdeen) said it appeared to him, at the first glance, that there was not much difference between the system before them and the Siemens regenerative system. There was no doubt that it worked by the method of taking back from the setting the heat that had been used. It was really, to his mind, amusing to see the twisting and turning that had been tried in order to overcome the Siemens patent. They knew that a great deal of improvement upon the Siemens furnaces had been made by different gas engineers; but he really thought that people should honestly accept the system, and not try to evade it. What advantage was to be gained by these over the Siemens system? He did not believe they would earn more by them than they would by the Siemens system.

Mr. M'Crae thought it would be a most unfortunate thing if it were to go forth from the meeting that Mr. Hislop's process was anything like the Siemens system. There were many points of difference; and it was only to the practical student that these points appeared.

Mr. Smith said the system took the heated air that used to escape to the chimney by the old process, back to be employed again.

The President called Mr. Smith's attention to the internal producer.

Mr. Smith said he did not dispute that.

Mr. Love, in reply, said he was obliged to the members for the kind manner in which they had received his first paper. Mr. West had asked what kind of coal they used. He stated in his paper that it was made up of one-half splint, one-fourth shale, and the rest second or third class cannel. In reference to the quality of bricks, this was very important. They found great difficulty in this respect, and had to get some bricks made with about 90 per cent. of silica in them. With these they found they had no difficulty, because they would stand heats up to about 2800° Fahr. before melting. At these heats the bricks stood two or three years' work. He certainly found the inside producer a very great advantage. They had no loss of heat by radiation, as was the case with the other system. As to the doors about which Mr. West had asked, they adopted those they had, so as to give accommodation for cleaning. They did not charge by the door to which Mr. West had referred. In his paper he stated that when they withdrew their clinker it formed itself into a natural arch. He thought the producer was better inside the wall of the oven, because the more they brought the producer forward, the more they exposed the bench to the action of cold air. Besides, if they were to bring the producer 15 inches or 2 feet forward, they would have difficulty in getting the whole of the coke spread over the entire area of the producer.

Mr. West: Oh, much better than by that means.

Mr. Love really thought that Mr. West was wrong. He considered it was desirable that they should have the coke as equal as possible over the whole producer; otherwise there would be waste.

Mr. West: But we do get it over the whole producer.

Mr. Love understood Mr. West to say he worked six-hour charges, while in Scotland they worked three-hour charges; and he (Mr. Love) certainly thought a *sine quâ non* process would be an improvement. With reference to the generation of steam, he might remark that they found quite sufficient steam in their pans, and they had to watch that they did not become burned. Mr. West asked about the cost of the bench. His reply was to refer him to the paper, which showed, in the second case, a cost at the rate of £18 13s. 11d. per retort, inclusive of everything. He would have been pleased, when he mentioned the subject of small works, if some of those who were engaged in them had given their experience of these furnaces, which were being built in various places in the country. With reference to flues, they considered two to be necessary to support the centre of the bench. They were constructed large enough to give plenty of room for cleaning out. Altogether he thought the centre wall made a much more stable job. Mr. M'Crae had made some remarks about small works, which he (Mr. Love) looked upon as complimentary; at the same time he thought that those at Paisley were not small, and he might say that he had taken from their books the figures he had given. They were simply their results as to the saving of coke and other matters.

Mr. M'Crae remarked that he never meant it to be inferred that Paisley had not most significant works.

Mr. Love said, with reference to the advantage to be gained by using their own as compared with other people's systems, in preparing his paper he resolved not to touch this matter, because he knew nothing about them. He simply wrote about what he knew at Paisley.

The President said he had been working with these furnaces for six years—his works being the first into which Mr. Hislop introduced them; and he made the statement openly, that at first they did not know very well how to manage them. They proved almost a failure, and cost a good deal. But at the end of three years they renewed them, and put in another furnace. It was certainly an improvement; still there was a want of that which they would have desired in the way of keeping up the regularity of the heats. Last spring they introduced two ovens—one of four, and the other of five retorts; and the results of their working had been most satisfactory. It took them all their time to keep down the heats—they were so excessive. In fact, if they closed up the ports, and prevented the air getting in, the result would, in some cases, be too much heat.

Mr. SMITH: What would be the saving?

The PRESIDENT could not say exactly what it would be in small works; but he should think as much as 25 per cent.

Mr. D. ROBERTSON (Dunoon) read the next paper, which was as follows:—

UNACCOUNTED-FOR GAS.

The term "unaccounted-for gas" is, of course, understood to mean that proportion of the annual manufacture which fails to give any indication of its existence through the medium of consumers' meters and other legitimate channels whereby the consumption of gas is recorded. While there cannot be any doubt in the mind of a gas manager at the end of his financial year as to the percentage unaccounted for, there may still be serious doubts as to where and how it is all getting lost; and it should be the aim of every manager of a gas-works, whether large or small, to leave nothing undone which could be expected to reduce this percentage still further. From statistics supplied for the year 1875 by the West of Scotland Association of Gas Managers, I find that the average return for leakage was 17·43 per cent.; and last year the North British Association returns show the average leakage to be 12·78 per cent.—a reduction of 4·65 per cent. in fifteen years, which clearly indicates that Scottish gas managers have, during that time, been fully alive to the importance of this branch of their business.

I am sorry to say that at Dunoon our percentage of gas unaccounted for is expressed by two figures—being 13 per cent. on our make; and it has taken a great deal of work to reduce it to even that figure, as our district is somewhat widely spread, with 17 miles of main pipes to supply 13 million cubic feet of gas per annum. One cause of our high percentage of leakage is that we have to provide distributing plant capable of supplying a population of 20,000 persons, three-fourths of whom reside in the district only three months out of every year; so that if our consumption was at all in proportion to the capacity of our mains, we should probably be in the happy position of some of our friends whose leakage is less than 5 per cent. I understand that our leakage twenty years ago was 33 per cent.; and six years ago, when I took charge of the works, it was 26 per cent.

—a condition of matters, which you will readily admit, is not conducive to paying high dividends.

For the past six years we have been using every means in our power to reduce the leakage to respectable proportions; and having managed to come within "measureable distance" of the average, we feel that ours is not altogether a hopeless case. Our mode of operation was, in the first place, to pierce the line of main in districts where we had reason to think gas was being lost; and, by this procedure, a great number of bad leaks were discovered and stopped. We have since, at different times, examined all the mains in a similar manner; and although it may cost more in wages for a month or two, at the end of the year it shows considerably on the right side of the balance-sheet. We also instituted a system of rewarding parties who call with information of escapes on the roadway; and we have found this plan to work admirably, as many a man or boy will feel a stronger inclination to walk perhaps half a mile to lodge the information, if he knows there is a shilling at the end of the journey, than if there is nothing. Besides, if any information is worth paying for, I consider it is that which, although costing only so small a sum, enables us to prevent waste to the extent of pounds in value. Scavengers, policemen, and postmen, who are constantly on the road, are our best detectors of escapes.

Mains and services we have found to be the chief causes of leakage; and attention directed to this part of the plant will not fail to yield beneficial results. I may say that I have found Pitkin and Niblett's coal gas detector of great service when searching for leaks, especially in places where it would be unsafe to use a light. But although mains and services are the chief outlets for unaccounted-for gas, they are not the only ones; for if consumers' meters are not regularly watered and overhauled, things are not as they ought to be. For instance, an old wet meter watered three times a year might be failing to register at least one-fourth of the gas passing through it. It might indicate correctly for three months after being watered; but in the remaining month, it registers nothing. The inspector goes his round, finds a certain quantity of gas registered, and considers it all right. The meter is then watered, and goes on for another three months, only to stop again at the expiration of that period. This might continue for years, and nobody be any the wiser, unless the inspector is of an inquiring turn of mind, and has the meter taken out and a new one put in its place, to pay for its own cost in a year or two.

I consider it to be mistaken policy to keep down expenditure by retaining in the place a lot of old meters that should be occupied by new and efficient ones. Anyone who has ever performed the duties of meter inspector can understand the feelings of a painstaking officer when he discovers a meter passing gas without registering it; and, on informing the consumer that his account will have to be charged on the basis of the same quarter in the previous year, he is usually met with a grumble, and the statement that "much less gas has been used this quarter." Some months ago a case occurred in my own experience, in which a lady complained very much of the amount of her quarter's account. She said she was sure the meter was going fast, as she had not burned all the gas for which she was charged. She wanted another meter; and to satisfy her, and also myself, I had the one she was using tested, when I found it registered 20 per cent. *slow*. It is almost unnecessary to say that I changed the meter. The lady was pleased, and so was I, but for different reasons. Of course, this is not an isolated case, for I have no doubt many of you could bring to recollection similar incidents in your own experience; but it certainly shows the wisdom of having a systematic testing of meters.

Service connections to mains are another source of vexation to a gas manager who wants to get his leakage down to as near zero as possible. I have on several occasions discovered connections where the main had been bored a little too wide for the tap. The form of tapping had been gone through, and the malleable tube not screwed in, but slipped in, and carefully rubbed with white lead to prevent it leaking. This was effectual probably for the first week, after which the pipe began silently to contribute its quota to the percentage of unaccounted-for gas. This kind of work I believe to be not owing to careless workmen, but to incompetent ones. Sometimes a local gas-fitter who is not conversant with this kind of work, and who perhaps has not suitable tools with which to do it, finding he has made a bad job, buries it underground as quickly as he can. But more often the mischief is caused by the individual known by the appellation of the "handy man," who is employed in many small works. I would advise managers of works like those of which I have charge, to steer clear of the "handy man" for main and service laying, and rather employ one who has served an apprenticeship to a trade such as a gas-fitter or a blacksmith, and who would be willing to put his hand to rougher work when necessary. I have found this to answer well in my case; and I am of opinion that it is the best plan. I would also suggest that, when a good man is obtained, he should be left a great deal to himself as to the manner in which he does his work. No doubt many of us are very particular and painstaking, more especially when we are supervising another man's work; but it is a mistake to be too exacting, as it is apt to sour a good workman.

Street lamps are, almost without exception, a certain source of loss in every town. This is owing, in a measure, to a separate service-pipe being required for each lamp (thus multiplying the number of connections to the main), but also, in a far greater degree, to the fact that much more gas is, as a rule, consumed than is allowed for when an annual charge per lamp is made. In our own district, for some years previous to 1886, the charge per lamp for the season from the middle of August till the end of April, allowing six nights out of every month when the moon was supposed to be shining, was 13s., using a No. 2 Bray's burner, from dusk till 11 p.m. But in 1886 the average meter system was adopted—the other conditions of lighting remaining the same as formerly; and at the end of the season we found that, instead of 13s., the amount consumed per lamp was 18s. 10d., subject to 7½ per cent. discount. This was equal to a reduction of 2 per cent. in our leakage account, and an increase in revenue of 5s. 10d. per lamp, although the lamplighters were under much stricter supervision, owing to the lamp-meters having been fixed.

Condensation is supposed by some to account for a large proportion of the loss; but I am inclined to believe that it affects the gas more adversely in quality than in quantity. My reason for this belief is that in one part of our district we have a stretch of 3-inch main-pipe extending three miles along the sea shore; and our total revenue from this main amounts to about £70 per annum, or 280,000 cubic feet of gas sold. Taking the percentage of leakage on this road as the average of the whole district, would give 36,400 cubic feet; and adding it to the gas sold, would give a total of 316,400 cubic feet. Allowing 1 per cent. of this for loss by condensation, yields 3164 feet; and supposing the specific gravity of the gas lost to be ·600, we should be able to pump out of the drips 144 lbs. of liquified hydrocarbons, or equal to about 14 gallons of pure liquor. We do not get so much pure liquor as this out of the 22 drips in the road in question, in the course of a year. Therefore, I think that I am justified in assuming that the loss by condensation is considerably less than 1 per cent.

It has been said that dividends are made in the retort-house, but may be lost in the street mains; and this remark applies with double force to small gas-works supplying widely-extended districts, where the gas, getting into long stretches of idle mains, has really nothing to do but to try and get out by the nearest leaky joint. Our duty is, of course, to keep it under control until it has reported itself at the consumer's meter, from which it passes into the service of another master, who, under the present system, may use or abuse it as he pleases. Our responsibility practically ends on our delivering gas into the consumer's meter; but we ought, if possible, to keep a watchful eye on its progress from the meter to the point of combustion, and endeavour, as far as lies in our power, to educate the consumer into the most economical and efficient way of using gas for lighting, cooking, and heating. If we do this efficiently, we shall have our reward in a larger consumption per customer, and thus open one of the readiest channels to a decrease in unaccounted-for gas, by increasing our sale of gas per mile of main.

Discussion.

Mr. P. WATSON (Stirling) said the first thing one ought to do was to ascertain whether or not the station meter was right; and the next, to see if the gas was maintained at about the summer temperature. Professor Lewes, of London, had delivered a lecture in which he gave tables for calculating the loss of gas for every degree of temperature, as well as by aqueous vapour; and he thought it would have been well if Mr. Robertson had consulted this lecture.

Mr. A. MACPHERSON (Kirkcaldy) said that, like Mr. Watson, he thought the first thing was to see that the station meter was registering correctly. Mr. Robertson had cited an instance in which he had had a consumer's meter 20 per cent. wrong. It was quite possible that his station meter was in error to the same extent, only he had never tested it. How he could have wet meters going for three months he (Mr. MacPherson) could not see, unless he had some extraordinary arrangement which was not to the Gas Company's interest. They in Scotland sold in winter a very large quantity of gas at a temperature of about 30° to 35° Fahr.; and if they measured it at 70° or 80°, it could easily be seen that they were not losing all the gas they were apparently doing, because they were over-measuring it when produced. Again, in selling it, they were under-measuring it; and so they had a deficit at both ends. Unaccounted-for gas was a thing he did not think was properly "leakage" at all. They must take all the circumstances into consideration. Some people were fortunate in having near their works large consumers who took 30 or 40 per cent. of the entire make of gas. Others, again, had to send the whole of it over a very large area. Then he also thought the number of consumers was to be taken into account. In the matter of unaccounted-for gas, they had had comparisons made between England and Scotland. But it must be remembered that in Scotland, in a town of (say) 30,000 inhabitants, they might possibly have 6000 consumers, for all of whom service-pipes had to be provided; whereas in a town of the same size in England, there would perhaps be only 2500 consumers. These were all matters that must be looked into before they could compare one place with another. At the same time, he thought Mr. Robertson was quite right in saying that no one ought to employ the "handy man," who was really the greatest loss a gas company could have. These men considered they were "handy;" but their employers found out, sooner or later, that they were not.

Mr. G. R. Hislop (Paisley) said that he would simply content himself with alluding to the subject of controlling the gas supplied to the public lamps. He had many times been surprised to find that there were no means of doing this. In many cases, no doubt, there was a loss of half the gas that was consumed. This was an important contribution to the leakage account. In Paisley he adopted the regulator system, which, he thought, was better than the average meter system. The simplest of all plans, in his opinion, was to get the needle governor burners which Mr. Peebles supplied, passing 2 cubic feet of gas per hour. They were perfectly accurate; and by putting them on all the lamps, and taking the total hours they burned, and the number of lamps, they had, at the end of the month or year, an exact statement of the quantity of gas burned. This was an exceedingly handy way of arriving at the consumption in the public lamps; and he was very glad to hear that Mr. Robertson had proceeded on proper lines in this respect.

Mr. T. D. Hall (Montrose) thought, with Mr. MacPherson, that there were hardly two places which could be put upon the same footing. In his own case, they had a very level town; and although, in one instance, they sent gas for three miles, he considered their leakage was very low. He agreed with Mr. Hislop that the principal causes of leakage in medium-sized towns were waste in the supply of gas to the street lamps, bad fittings, bad stopcocks, lights blown out and the gas turned on again, &c. In his own town they did not employ regulators, on account of the place being very level; but they used a first-class burner, and with this, the consumption being understood to be

2½ (though he often found it was 3) cubic feet per hour, they had, he was sure, very little loss. Then the lamplighters frequently, when cleaning the lamps, let a burner "blow" for a few minutes, in order to get rid of water; and this gas was, f course, all lost.

Mr. J. M'CRAE (Dundee) remarked that the subject before the meeting was one which had interested him very much for a long time, because this was the most flexible matter in their balance-sheets. Mr. Robertson's paper had been very carefully considered; and he (Mr. M'Crae) thought it was perfectly true. He must, however, diverge a little from the writer's line of argument to say that meters, and meters alone, were the cause of the leakage. He had just had an experience which illustrated this. They had a 200-light dry meter which was 31 per cent. slow. Now, a number of such meters would make a very serious difference at the end of the year. He had sent into every lane, alley, square, and court in Dundee, and had also caused every manhole to the public sewers to be tested by the smell, and all the leakage that could be discovered in this way was a mere trifle not worth mentioning. The great source of leakage was undoubtedly the meters; and he thought that all kinds of meters should be tested periodically. By doing this, it was wonderful what they would discover; and they would be able to reduce their leakage by it. In Dundee the leakage only amounted to about 7 per cent. It was perfectly true, as Mr. MacPherson had stated, that they could not compare two towns, because the circumstances might be so different that they really could not institute a comparison. He thought the subject was worthy of the most scientific attention gas managers could bestow upon it, in order to find out, first, whether or not the unaccounted-for gas was lost; and secondly, if it was lost, how this was to be prevented.

Mr. W. KEY (Glasgow) said he had listened with pleasure to Mr. M'Crae's remarks. He thought, however, that the one as to meters being the sole cause of the unaccounted-for gas was not altogether correct. He would relate his own experience. Mr. M'Crae said gas managers should go about this matter scientifically. Some twenty years ago, in a place where he was Manager, the gas account was paid by the Police Commissioners; and they had the two meters which were upon all the lamps in the town—the all-night and the short-time lamps—in the Police Office. The all-night lamp burned over the office door; and the short-time lamp in a lane behind. Believing the Gas Company were not getting payment for all that was consumed in the town, and taking advantage of the " hue and cry " raised for dry meters, he suggested to the Commissioners that they should have dry meters put on a number of lamps throughout the town. The Town Council assented; and 20 dry meters were fixed. In the first six months there was an increase of exactly 100 per cent. on the street lighting account. This was apparently rather too much to give; and they were not allowed to have it long. The accounts began to show a decrease so rapidly that he could not tell how it was; and he set himself to find it out. He had to procure a pair of goloshes with which to travel the streets during the night; and with the aid of these he discovered it. He and an assistant went out at night for some months, and walked about till four and five o'clock in the morning. One night they were upon a hill where there was a meter lamp; and they ensconced themselves behind an entrance gate. Two policemen came up; and as soon as they arrived at the lamp-post, one climbed upon the other and extinguished the light.

Mr. Watson remarked that a good many of the managers present were young men, but if they referred to an early volume of the *Journal of Gas Lighting*, they would find a case of a manager in a town on the Clyde who had no leakage; but when his station meter was examined, it was found to be 20 per cent. slow. That was the reason he had no leakage.

Mr. Robertson, in reply, said he felt very gratified that his paper had been the means of raising so good a discussion. He did not attempt to touch the reasons of unaccounted-for gas so much as to give the members his experience. They could follow his example if they pleased. Mr. Watson had made some remarks about the station meter. To these he could only reply that his meter was correct. Since reducing the leakage, they had considerably increased the production of gas per ton of coal carbonized, which showed that it was not at the expense of the make that they had lowered it. Mr. Watson had said he had never known of a meter that stopped at the end of three months. He (Mr. Robertson) had met with a number of them. He had found a wet meter registering correctly at the end of this period; and he had gone again at the end of the three months, and found it standing. It seemed to be the case with some wet meters that, when the water fell below the scale level, the gas passed without actuating the drum. He had no doubt that wet meters caused a great deal of the leakage; and unless they were properly watered, they failed. He did not think, however, that wet meters were the sole cause of unaccounted-for gas; but he believed that dry ones also required to be looked after. He thanked the members very kindly for the way in which they had received his paper.

On the motion of the President, a vote of thanks was accorded to Mr. Robertson.

Mr. D. Macfie (Edinburgh) read the last paper, on

REGENERATIVE GAS LAMPS,

WITH SPECIAL REFERENCE TO THE LIGHTING OF LARGE INTERIORS.

The system of regenerative gas lighting has been on its trial for a number of years; and it may not be out of place to inquire whether, and how far, it has met with popular favour and proved worthy of recommendation and general adoption. I am not here to discuss the relative merits of competing lamps, and shall confine my remarks to the system generally and to its particular application; for I wish to approach the subject from a practical, rather than from a scientific, standpoint.

The introduction of the system is one of the most important events in the history of gas lighting; and it is matter of surprise that its merits have not been more freely recognized. Several causes have, no doubt, contributed to this state of matters. First of all, the public maintains a sceptical attitude towards all improved methods of gas lighting; and consumers generally (while not proof against the wily burner hawker) do not take the trouble to understand the merits of the regenerative lamp, and often, when convinced, will not take the further trouble of careful superintendence. Society, too, has developed a preference for table decoration under a subdued light in a canopy of gloom—resulting in "the cult of the paraffin lamp;" and yet the public, which patiently endures the inconveniences of oil-lamps, thinks it too much trouble if progressive methods of gas lighting require more than the turning of a tap and applying a light.

But the public is not alone to blame; for regenerative lamp makers, by a scale of prohibitive prices, have themselves barred the progress and popularity of the system, and limited their field of operations accordingly. If I were in the councils of any lamp-making syndicate, I should (knowing as I do the difficulties and worries of the regenerative-lamp crusade, and the limitations under which it is conducted) recommend them to cater rather for a large demand at popular prices, so that new sources may be tapped, and the lamps brought within the reach of all.

It may perhaps be suggested that the members of the gas industry, who know the merits of the system from a scientific standpoint, are not without rebuke in their lack of enthusiasm for the cause; but it must be borne in mind that there are inconveniences connected with the fitting and the manipulation of regenerative lamps, and also risk of failure owing to carelessness or ignorance on the part of gas-fitters. For it is no more than the truth to say that gas-fitters generally have taken little pains to understand or appreciate the system. They have been shy of tackling the mysteries of the lamp's parts and accessories; and now with their timidity, and again with perverted ingenuity in the matter of fitting, they have too often upset the essential safeguards to success, and made the system a scapegoat for their own offences. Where fitters have got hold of the essential principle of regenerative lamps, and taken the trouble to understand the novel features of the fittings, a happier state of matters has been the result.

It must, of course, be admitted that one of the chief drawbacks to the general adoption of these lamps, lies in the complications, nice adjustments, and delicate working parts, as yet inseparable from their efficient working. The advantages of the system, in developing the illuminating power of gas, are freely recognized; and, without going into fractions or technicalities, it may be stated as a general rule, that any ordinary regenerative lamps may be relied on to increase by at least 150 per cent. the light from any given consumption per hour. In practice, one may safely guarantee that equal light will be got from little more than one-third the consumption of flat-flame burners in the usual type of fitting; while, for a given consumption, it is equally safe to count upon almost treble duty from regenerative lamps as against ordinary burners.

If, for example, we take a room 36 feet by 18 feet, lit by twelve burners consuming in all 42 cubic feet of 25-candle power gas at ½-inch pressure, the result may be taken at 210-candle power. If we substitute two regenerative lamps consuming a total of 16 cubic feet per hour, against 42 cubic feet, equal light would be maintained; while if two larger regenerative lamps be employed, consuming in all 42 cubic feet per hour (equal to the twelve burners superseded), the lighting power would be almost trebled, and the room would be much overlit. If the system under discussion trebles (or only doubles) the lighting value of coal gas, it is alike the interest and duty of all concerned to recognize the fact, and make it known where such information would be serviceable.

By the invention of the regenerative lamp, gas authorities have had put into their hand the strongest weapon of defence, in face of the electric crusade, which in its warfare is not slow to use any weapon that comes handy, so long as gas is the object of its onslaught. In a fair fight, gas has nothing to fear from its most powerful rival. But while it may be a sign of strength to despise your enemy, this is not always a sign of wisdom; and in the public interest I take the liberty of suggesting that sellers of gas should make it plain by some official pronouncement, that consumers are misled as to the relative cost of gas *versus* electricity as an illuminant.

It would be easy to show—first, that on the most favourable computation, and under the best known system of distribution, users of electric light must be prepared to pay at least three times the cost of gas burned in the most ordinary way. Second, that it is possible to light dwelling-rooms with gas on approved methods as effectively as with electricity at less than one-fourth of the cost, with no risk of failure in the supply. Third, that taking the figures of electricians as a basis, the cost of lighting rooms with electricity, as compared with 25-candle power gas at 4s. 2d. per 1000 cubic feet, is about six times the cost of regenerative gas-lighting, and three times the cost of flat-flame burners of the ordinary type.

No clear understanding exists as to a standard of comparison between gas and the electric light; and electricians have been allowed to base their figures not on the best, but on the least favourable methods of burning gas. With our present candle-power standard it would be too much to expect our rivals to take any account of improved methods of developing the illuminating power; but we have the right to insist that some regard be paid to the quality of gas under comparison, as well as to the price paid for it per 1000 cubic feet.

It appears as if the best quality gas known to electrical engineers is of 16-candle power, while they are wide awake to the *price* of 25-candle power gas. As a case in point, I think it proper to call attention to a most invidious and misleading comparison, which appears to have been made (without protest) before the Royal Scottish Society of Arts in Edinburgh a few weeks since, as reported in the *Scottish Leader* of May 12. The speaker was Professor A. B. W. Kennedy, the Engineer-in-Chief to the Westminster Electrical Supply Corporation; and his subject was "The System of Electric Lighting at Present in Use in Various Parts of London." He is reported to have said that "The cost of electric light in houses" would "probably be from 20 to 30 per cent. in excess of gas at 3s. He believed that gas in Edinburgh was 4s.; and probably their houses could be lit by electricity cheaper than that." You will notice that there is not the least hint as to difference of quality in the rates quoted per 1000 cubic feet. But the Professor goes on to say that "the cost of electricity was one-farthing per hour for an 8-candle lamp, or one-halfpenny per hour for a 16-candle lamp." Let us charitably assume that Professor Kennedy was not aware that, while he spoke, Edinburgh was being supplied not with 16-candle power gas (which I assume covers his reference to 3s. per 1000 cubic feet) but with gas of 25-candle power, which we will take at 4s. 2d., instead of 4s., as quoted by the Professor; and now see how these figures work out. Let us find an equivalent to the 16-candle power lamp which is said to cost ½d. per hour. With 25-candle power gas at ½-inch pressure, we get 5-candle power per foot; and with a consumption of 3½ feet, we get 17½-candle power, as against the 16-candle power electric lamp. We may burn 3½ cubic feet per hour for 100 hours for less than 1s. 6d., while Professor Kennedy wants 4s. 2d. for his electric lamp, or 175 per cent. *dearer*, instead of being "something cheaper than our gas at 4s. per 1000." In calling attention to this misleading statement, I am content to base my comparison on the result from ordinary gas-jets, leaving out of account the enhanced results attainable by regenerative lamps.

I do not share the fears of those who anticipate an easy victory for electricity as the popular illuminant; while at the same time we should be prepared for its adoption as a luxury amongst those who can afford to pay for it, and who will not look too narrowly into the cost of electrical installations, nor consider too closely the charge for renewals.

Having said so much by way of introduction, it is my duty to point out wherein the system of regenerative gas lighting is in advance of the open flat-flame system which it has sought in some measure to supersede. Before the introduction of the system under discussion, it may be said that there had been no essential change in the early types of Argand, batswing, and union burners, and that all improvements were directed to the combining or perfecting of these primitive types. It is true that, apart from the many trumpery devices foisted upon the public by way of "economizers," real progress had been made in the direction of controlling or governing flat-flame and Argand burners, and increasing their efficiency. This was done by careful selection of tips, and automatic control of pressure, on the sound principle of burning gas with large volume and low pressure. In this connection it is enough to mention the names of Sugg, Peebles, and Bray, to remind us of their attainments in this and kindred directions. But with the results of these inventors before us, it may be said that nothing more is to be expected on the old lines, unless (by the way) it should happen that Mr. Hislop's painstaking experiments, as to the standard angles in the drilling of burners suited to the various qualities of gas, may be found to mark a still further stage in advance.

Now that we have the regenerative lamp before us as an accomplished fact, it seems strange that gas engineers should have been so long content to aim at perfection on the old lines. The regenerative lamp appears all so simple when the thing is done. You have only to exclude cold air contact from the flame, and in its place supply a stream of heated air by the influence of the flame itself, and turn your Argand burner upside down, when, behold, your lighting power is doubled or trebled, as the case may be. It is immaterial whether this great increase is within the flame itself, or is enhanced by the disposition of the flame; for it is after all with the result that we have to do. In view of the regenerative lamp, the deficiencies of the flat-flame system become apparent. With the exception of sun-burners (the most extravagant of all gas-burning apparatus), primarily devised as much for ventilating as for lighting purposes, gas appliances seem to have been devised more as a means of lighting the upper walls and ceiling than of the habitable portion of our apartments. The result from flat-flame burners could hardly be otherwise; for the source of light being as a rule above the head-line, and the radiation of light being chiefly outwards and upwards, the greatest brilliancy is thrown on the ceiling, where it is least required. The public had got so accustomed to this rather pleasing effect to the upward eye, that for a time the chief objection to regenerative lamps was that the ceiling was left in shadow. But for practical purposes that seems rather an advantage than otherwise; the light being thrown down, where it is most wanted. I hope to show that in all cases where it is essential to light up decorated ceilings, this may be done by the use of non-ventilating lamp groups.

In this age of sanitation, when gas-lit rooms come under the bann, it is our duty to show that, while gas may be an active means of vitiating the atmosphere when combustion is imperfect (like candles and lamps, only in a lesser degree), improvements have been made towards the perfecting of combustion by means of the regenerative burner. It requires but little demonstration to show that, if equal light can be got for half the gas consumption, the vitiation of the atmosphere is greatly minimized; and it becomes apparent that if the source of light is close to the ceiling in ordinary rooms, and as much as 15 to 20 feet from the floor in larger apartments, the living conditions must be healthier in a corresponding degree.

So much may be claimed for the ordinary non-ventilating type of lamp which discharges the minimized products of combustion near the ceiling. But so little are the laws of gas-burning understood by the public, that it is a common experience to find consumers who have tolerated, without question, the vitiated atmosphere of a gas-lit room with flat-flame burners consuming 30 cubic feet per hour, raise the question as to ventilating tubes being required when a regenerative lamp, burning 12 cubic feet an hour, has been suggested instead. The funnel-shaped exit of the lamp suggests that there is something to be got rid of; while it has never occurred to them that steps should be taken to remove the products of combustion from burners imperfectly consuming almost treble the amount of gas. It is true that thermometrically a room lit by non-ventilating regenerative lamps may be warmer in the vicinity of the flame than within the same distance of a gaselier; but the objection to gas-lit rooms is not due to their thermometer heat, but to the vitiation of the atmosphere and consequent feeling of oppression, which state of things is absent when a non-ventilating regenerative lamp is in use.

As a case in point, permit a personal experience. I usually sit under a lamp of this type, burning 9 cubic feet per hour. The light is brilliant, and the atmosphere cool and pleasant for hours together. If an adjournment is made for an hour or two, to another room in which some 20 cubic feet of gas are consumed by Peebles governor burners, the atmosphere becomes oppressive, and it is a relief to return to the cheering beams of the regenerative lamp. This is a fair comparison between the very best type of flat-flame burner and an approved form of non-ventilating lamp.

The merits of regenerative lamps as a combined lighting and ventilating apparatus cannot be too well known. So efficient are they in this respect that plants and flowers may with safety be left in such rooms, while the injurious effects of gas burned in the ordinary way is proverbial. Efficiency cannot, however, always be guaranteed, owing to the faulty conditions which prevail. There is the difficulty of getting access into the proper chimney, and the uncertainty of a good up-draught in any case. When rafters and angles prevent connection with the chimney of the room in which the lamp is to be fixed, flue-pipes are sometimes led into an adjoining flue; but this is to court failure, or attain an accidental success. There is also the not uncommon difficulty of securing an efficient fresh-air ingress to the room, which is as essential as a good outlet.

A case in point may illustrate this. Ventilating lamps were wanted in each of two adjoining rooms of equal dimensions, and apparently similar conditions, with easy access into each chimney and a good up-draught. One lamp burned perfectly, and proved an efficient ventilator; while the other refused to do either. Of course, the lamp was condemned; and it was vain to point to the efficient lamp in the next room, and to suggest that the fresh-air ingress was deficient. This was easily proved by merely leaving the door ajar, or the window slightly open; and it led to the adoption of fresh-air intakes with the desired effect.

So problematical is the success of connecting ventilating lamp flue-pipes with coal flues, that it seems better (where this is possible) to carry separate flue-pipes to discharge above the roof. But then, as always, it is necessary to pack the flue-pipes in their whole length, and to use an exhaust ventilator double-cased and packed in the same way. Otherwise the best ventilator will (under certain conditions) act as a refrigerator, and prevent the exit of the heavier gas.

Objection is taken to the trouble involved in the use of regenerative lamps; but if properly fitted and attended to, the trouble is almost *nil*. If users will not keep the glasses clean, nor look to the burners, disappointment must follow. The trouble lies less in the lamp than in its accessories; though in several respects these have been simplified. The lamps, too, are held largely responsible for blackened ceilings. But the risk is greatly exaggerated; and when the lamps burn in a normal condition, there is no more (but probably much less) carbon deposit, than from open-flame burners; and while in the latter case the carbon particles float in the air high and low, with regenerative lamps, the evil, if any, is concentrated, and the particles are projected on to the ceiling, where they can do least harm. And yet it is true that the charge against both systems, of blackened ceilings, is unwarranted. Some years ago Mr. Sugg conclusively showed that "the ceiling discoloration arises from the state of the atmosphere, which, in large towns, is largely mixed with heavy smoke particles, and from the dust and dirt created in rooms by the use of coal fires, as well as from the smoke which more frequently than is supposed, escapes from the fireplace into the room." A regenerative lamp being a greater heat-centre, and closer to the ceiling than the ordinary gasalier, does of course attract these floating particles, and by its heat transfixes and discolours the deposit—in which, however, there may be no trace of carbon.

In one case, a professional friend—satisfied in all other respects with his lamp—complained of it smoking the ceiling, and wished it removed. On close inspection, it was made quite clear that the discoloration was due to dust particles which (in the process of cleaning the room and otherwise) had been drawn into the heat zone, and found rest on the surface of a heavy and porous ceiling-paper. In an asylum dormitory lit by regenerative lamps, a like complaint was made; and what to all appearance was a badly smoked ceiling, showed simply a deposit of "fluff" on a varnished wood ceiling where shaking bedclothes had whirled the loose particles within the heat radius of the lamps.

There are, of course, abnormal cases in which a brilliantly lit room may, by the failure (from one cause or another) of the lamp regulator, be transformed into a carbon manufactory; and while the cause of failure may be so explained, this is a very serious defect, and is really *the* weak point in regenerative lamp lighting. It is hopeless to argue with a consumer that it may be worth while to run the risk of an occasional blackened ceiling in view of other compensations; and it is idle to suggest (when this happens) that the failure is due to the accidental upsetting of a nicely adjusted scientific instrument which is not as yet infallible. You have in this Association an esteemed member, who perhaps has done more than any other man to perfect this instrument; and it is no derogation to him when I say the unfailing regulator has not yet been devised. Until he or some compeer shall invent a regulator at once simple in its construction, free in its working parts, easily accessible, and unfailing in its action under ordinary conditions, the chief obstacle in the progress of regenerative gas lighting has still to be overcome.

The matter of efficient control is much simplified when (instead of a single lamp, which has to be attached to existing fittings) a complete installation is to be fixed on one range of pipes. It is then possible to secure practically unerring control, by the use of an improved make of mercurial pressure governor fixed conveniently on the supply-pipe. The governor may be loaded to the required pressure, and the volume of gas adjusted by regulating screws fitted in the key-plugs of each lamp-tap. Here, there is no risk of failure, as in volumetric regulators which are "adjusted to finer issues," and are more liable to local disturbance. These mercurial governors should be locked and sealed, to prevent ignorant interference with the conditions of pressure. The advantages underlying this method of controlling pressure and volume, have made easy the problem of lighting large interiors. In the earlier stages, this was made impracticable by the method of leading separate pipes to each lamp, and the fitting of regulators on each ascending pipe. It was then usual to keep each lamp burning with a bye-pass flame, which in large lamps consumed about 2 cubic feet of gas per hour. Suppose twelve lamps fitted in a public hall, each consuming 15 cubic feet per hour, and that the lamps were used two hours nightly for a week. The consumption during fourteen lighting hours would be 210 cubic feet, while the gas consumed on the bye-pass during the 140 hours the lamps were kept ready for use, would be 280 cubic feet, or one-third more than the cost of gas for lighting purposes. To prevent this prodigal waste, pilot lights burning 1-10th of a foot per hour were introduced, and should be universally adopted.

In accordance with the sub-title of my paper, I now proceed to describe alternative methods by which regenerative lamps may be applied with success to the lighting of large interiors. In such buildings the advantage and superiority of regenerative lamps, when effectively distributed, become apparent—not only on the score of economy, but of atmospheric conditions, and because of the steady and brilliant effect unattainable by any system of flat-flame burners.

The first to be described is a form of ceiling light for a private room 35 feet by 25 feet. The object here was to hide the outline of the lamp-shafts and to fix the lamps close to the ceiling in one cluster, rather than from three centres. The ceiling plate (4 feet in diameter) was covered with asbestos card-board, to prevent any heating of the floor above. The lamps depended from one fixing-plate, to which the three lamps were connected. The bottom disc was connected with the ceiling plate, and admitted the lamp shafts and body—showing only the lamp rims and glass shades underneath. The construction was concealed by a series of large metallic leaves surrounding the lamp cluster, which may be decorated in keeping with their surroundings and removed separately for repairs. The gas supply is controlled in the method I have already described; and the lamps may be cleaned from ordinary step ladders.

Another method of lighting a similar room was shown in operation in the meeting-place. This three-lamp cluster was simply fitted in the place of a gasalier temporarily removed. There was no attempt to disguise the lamp-casings, which were pendant from three iron tube arms with wrought-iron scroll-work. This group was fitted for conditions where wall taps and a pressure governor cannot be applied. Above each lamp there was a down-current regulator adjusted to pass 9 cubic feet of 25-candle gas at any varying pressure. Each lamp was fitted with a lever tap having a pilot-tube bye-pass attached. In the first instance the three lamps were arranged to be controlled by one tap. In this cluster as shown, however, one or more of the lamps could be lit as required. This style of pendant is well adapted for the lighting of large interiors; for such clusters are at once more effective, and less distracting to the vision than a scattered constellation of single lamps, while the fitting is greatly simplified.

A large installation of this kind has just been accomplished with complete success, where the problem was to light a Drill Hall having a lofty open roof and absorbent brick walls; the floor space measuring 137 feet by 87 feet. An unsuccessful attempt had been made to light this spacious interior by four sun-burners, consuming some 300 cubic feet of gas per hour at 1 inch pressure. These have been superseded by twenty regenerative lamps, consuming in all 260 cubic feet per hour; and these are disposed in five pendant groups fitted 16 feet above the floor-line. The lamps are controlled by one mercurial pressure-governor and adjustable taps. Each group is fitted with a tap in the down-rod; but the twenty lamps may be lit simultaneously by a controlling tap. Pilot lights are fitted to each lamp; and these do not in all burn more than 2 cubic feet per hour, costing less than 9d. per week. The result is an entire absence of shadow on the ceiling, and an equal distribution of powerful and well-diffused light.

I now call your attention to an arrangement [illustrated by a wall diagram] for which entire novelty, and some credit, may perhaps be claimed. It is a common difficulty in dealing with large and lofty interiors, to devise an effective lighting scheme, at once easy of manipulation and free from the foul and flickering effect of masses of open jets so often resorted to on the score of cheapness and simplicity. I have shown that in limited as well as spacious apartments, where pendant groups may be reached with step ladders, regenerative lamps can be used with advantage. But in halls say 40 feet to 50 feet high, with or without galleries, these are not always suitable. The drawing showed how the difficulty may be overcome, in buildings where there is a height of four feet or more in the ceiling loft. The problem of which this is a solution is to arrange one or more lamp groups so that the globes shall be just under the ceiling line, with one central lamp somewhat lower. The lamps must be accessible from the ceiling loft for cleaning purposes, and sustained in position during that operation or when in use. This is accomplished by the device of a double-limbed arrangement of gas-pipes (one carrying the supply of gas to the burners and the other to the pilots), and these limbs are attached to strong plate-joists fixed to the ceiling joints. At the moveable ends of the limbs, strong swivel-joints connect to cross arms, on which the lamps are fixed by suitable attachments to centre points as required; the pilot supply following the same course. The whole apparatus in front of the fixed swivels is attached by steel-wire rope to a pulley in the cross beam, and connected to a special form of self-sustaining hoist, by which the lamp group may be raised or lowered at will without disconnecting any part of the attachment. The ceiling plate is bolted to a strong wrought-iron frame, set on edge and securely fixed to suitable bearers, so that the attendant may (if required) get under the lamp group when raised for cleaning. Similar lamp groups to this have been fitted in several large halls, from 40 feet to 50 feet above the floor-line, and they are under specification for the lighting of a city church.

It may be suggested that there must be a great loss of light when the lamps are fixed 50 feet above the floor-line; but one cannot apply the same rule here as in open-flame burners, and the result is the best answer to that suggestion. In the first installation under this system, it was stipulated that the lamps used should give a light at least equal to three large sunburners (which in actual use consumed 800 cubic feet of gas per hour) at a greatly reduced cost. Three lamp groups of twenty lamps in all, consuming 260 cubic feet, were employed. The following extract from the official report to the shareholders of the hall in question is the best commentary as to the result:—

"These lights have met all the expectations formed of them. The hall is better lighted even than before, and with a very large saving of cost during the short time the new system has been in use. The Directors confidently look to a considerable reduction of expenditure on this head in future."

After fifteen months' trial, the Chairman, in submitting the report for the following year, said:

"The adoption of the lighting system had produced the substantial saving in the expenditure which was anticipated when it was introduced. The expense of gas in the previous year was no less than £135, and for the past year it was only £91, which, he thought, was a sufficient proof that they were right in going into the expenditure."

Apart from the effective and economical features of the system, and the ease with which these lamps may be manipulated, it will be apparent that a distinct gain in the matter of ventilation is secured. The ceiling plate is perforated; and the heat of each lamp is utilized in extracting the vitiated atmosphere into the ceiling loft, while the products of combustion discharge above the ceiling. It may be objected that this arrangement does not permit of ventilating tubes being led from each lamp group; but to connect the lamps in any such way would simply be to court failure. The better plan is to arrange an independent scheme of ventilation, and this has been done successfully in several of the halls referred to. An indirect advantage of discharging the heat products from the lamps into the ceiling is that the ventilating shafts in the loft are in the vicinity of artificial heat, and are the more likely to act efficiently.

In conclusion, I trust that in stating the case for regenerative lamps I have managed to steer clear of controversial matter as it affects competing lamp patents; and while I shall not (if challenged) be slow to state reasons for the faith that is in me, in my unwavering attachment to a certain type of lamp which shall be nameless, I feel sure that you will approve my desire to limit the discussion to the system of regenerative lighting generally, and to its particular application. May I hope that its interest will be none the less on that account, and that some good purpose may be served by the discussion of a subject to which I have devoted not a little attention. I court the frankest criticism, and shall be happy to make myself plain on any point on which I may not have made my meaning clear.

Discussion.

The PRESIDENT suggested that, as the time for adjourning had arrived, the discussion on the paper should be postponed.

Mr. J. M'GILCHRIST (Dumbarton) moved that the discussion be delayed until the next conference.

The PRESIDENT said he thought they should accord their hearty thanks to Mr. Macfie for his very excellent paper.

Mr. J. M'CRAE (Dundee) did not consider it wise, in an assembly such as theirs, that trade business should be discussed. He said he spoke in all kindness, and in deference to the writer of the paper; but he thought it ought to have been submitted to the Committee before it was read. In his opinion, they ought not to criticize trade business of any kind whatever.

Mr. D. M. Nelson (Glasgow) said there was nothing at all new in the paper. There were several descriptions of regenerative lamps, but nothing novel submitted.

Mr. Macfie said he was in the hands of the meeting. He had come prepared for the discussion of any part of the paper; but he waived this entirely. He read the paper by the invitation of the Association; and he thought he had avoided everything of a trade nature.

The President did not consider it was right to bring up this point at all. If they invited a gentleman to prepare a paper, they should listen to it.

Mr. D. Bruce Peebles thought it was unfair to Mr. Macfie to continue the discussion when he had no right of reply. Mr. Macfie had given the meeting a very excellent paper; and he complimented him upon it.

The matter was left over till the next day.

The Question-Box.

This useful institution was largely taken advantage of at the meeting; the President reading the following four questions which had been placed in it:—

1.—Is it not advisable that this Association should recommend coalmasters to fit up small testing gas-works of their own, so that they might be able to send out practical working analyses instead of laboratory analyses, as they are misleading in purchases of coal for practical working in gas-works; and in the case of any dispute as regards quantity of gas per ton, or illuminating power, 1 cwt. of the coal could be selected from the heap and sent back to the colliery, and if deficient according to the purchase of the coal, the difference could be easily rectified with satisfaction both to the coal merchant and the gas company?

2.—Is a gas or a steam engine the most suitable motor for the exhauster in a small gas-works?

3.—What would you suggest as the best method for the prevention of rust on the side of purifier covers?

4.—What is understood by the use of dry lime instead of milk of lime in purifiers?

The reading of these questions brought the day's business to a close; and the members afterwards dined together.

Concluding Business.

On the following morning, the remaining business was disposed of.

On the motion of Mr. Alex. Smith (Aberdeen), the four questions which had been placed in the box were remitted to the Committee to consider and answer.

The President's Medal was presented by Mr. D. TERRACE, of Middlesbrough.

Mr. ROBERTSON having appropriately acknowledged the gift,

A vote of thanks was accorded to several Edinburgh firms who had exhibited appliances connected with their industry.

The PRESIDENT having intimated that Mr. Macfie had been called away to London, it was arranged that the discussion on his paper should be made the first business at the 1892 meeting.

A vote of thanks was then accorded to the Secretary for his services; and several other formal items of business having been transacted, the proceedings terminated.

THE EXCURSION.

The members subsequently drove to Roslin, by way of Dalkeith, where, through the courtesy of the Duke of Buccleuch, the conveyances were permitted to pass through the grounds of Dalkeith House, his Grace's principal residence. On arriving at their destination, the party spent some time in exploring "Roslin's rocky glen," as sung of by Sir Walter Scott—a charmingly romantic dell, clothed at the time of the visit in Nature's most lavish garb of green. Opportunity was also afforded of seeing Roslin Chapel, the most ornate piece of ecclesiastical architecture in Scotland. Dinner was served in the village hall; and in the evening the party returned to Edinburgh. The weather was delightfully fine during the whole of the day; and this, with the beautiful and interesting sights which were placed before the party, made the excursion one of the happiest which had ever taken place under the auspices of the Association.

NORTH OF IRELAND ASSOCIATION

ANNUAL MEETING, AUG. 11.

This Meeting was held in the Council Chamber of the City Hall, Belfast—Mr. R. Ross, of Dungannon (the President), in the chair. There was a good attendance of members; and among the visitors was Mr. W. A. Valon, Assoc. M. Inst. C. E., President of The Incorporated Gas Institute.

ANNUAL REPORT.

The preliminary routine business having been disposed of,

The SECRETARY (Mr. J. Whimster, of Armagh) submitted the report of the Committee, as follows:—

The Committee, in presenting their annual report, have to congratulate the members on the increasing vitality and popularity of the Association. The membership now numbers 50; and the financial statement presented herewith, vouched by the Auditor, shows a balance in hand of £11 19s. 2d.

The Committee expected to have a specially attractive programme for the Belfast meeting; but they are sorry that, on account of personal and family affliction, two gentlemen who had promised papers have been obliged, at the last minute, to withdraw—viz., Messrs. Travers, of Cork, and Outon, of Inchicore. However, three papers are forthcoming on subjects of great importance to us all, which should open up discussions at once profitable and interesting.

We shall also have the privilege of inspecting the Belfast Gas-Works, which are well known as one of the best equipped establishments in the United Kingdom, and which contain what, as yet, no other gas-works have—a complete plant for gas purification in closed vessels, on the Claus system.

Your Committee have had a communication from Section C of the Royal Commission on Labour, with regard to witnesses representative of the gas industry; and, on the suggestion of the Committee of the Manchester District Institution of Gas Engineers, they have resolved to co-operate with the other Associations of Gas Managers, so as to take united action in the matter.

According to Rules 25 and 26, three members of the Committee retire now, and are ineligible for immediate re-election. The retiring members are Messrs. Stormonth, Featherstone, and C. W. Mearns.

(Signed) R. ROSS, President.
JAS. WHIMSTER, Hon. Sec.

On the motion of Mr. E. STEARS (Lisburn), the report was adopted.

New Members.

The Secretary said he had four gentlemen to propose for admission to the Association—three ordinary members, and one extraordinary member. The former were Mr. Hands, of Enniskillen, Mr. Miller, of Cookstown, and Mr. Harrison, of Aughnacloy; and the latter was Mr. E. W. T. Richmond, of Warrington.

Mr. W. S. Stormonth (Coleraine) seconded the proposition, and it was carried.

Election of Office-Bearers.

The Secretary said that the next business was the election of office-bearers for the ensuing year; and he had very great pleasure in proposing that their respected Vice-President—Mr. D. M'Callum, of Omagh—be elected to the position of President for the coming twelve months.

Mr. T. Frizelle (Holywood) seconded the motion, and it was carried by acclamation.

Mr. W. B. Featherstone (Dundalk) next moved that Mr. W. S. Stormonth, of Coleraine, be appointed Vice-President.

Mr. E. Stears seconded the motion, and it was carried unanimously.

Mr. M'Cullum and Mr. Stormonth haivng briefly thanked the members,

Mr. Whimster was cordially re-elected to the position of Secretary for the ensuing year.

The Secretary expressed his obligations to the members for their renewed confidence in him; and then stated that there were three vacancies on the Committee to be filled up, caused by the retirement of Mr. W. S. Stormonth, Mr. W. B. Featherstone, and Mr. C. W. Mearns, who were not eligible for immediate re-election.

Mr. Stormonth proposed that Mr. J. Nisbet, of Portadown, Mr. C. Todhunter, of Ballymena, and Mr. W. Walker, of Hillsborough, be elected to fill the vacancies.

Mr. D. Williamson seconded the motion.

Mr. Richmond thought they should have upon the Committee some representatives of the more remote districts, as he believed that in this way they would strengthen the Association, and widen the interest taken in its operations. He was glad to see present on that occasion two gentlemen from the West—Mr. P. J. Salmon, of Galway, and Mr. C. B. Tully, of Sligo——and he proposed that they should be elected members of the Committee.

Mr. M. Martin (Drogheda) seconded the motion.

The **President** said they had now before them five names for the three vacancies, and he would take a poll.

Mr. **Williamson** proposed that Mr. Salmon, Mr. Todhunter, and Mr. Walker should be elected; and eventually this was unanimously agreed to,

The **Secretary** then proposed that Mr. E. Stears should be re-elected to the position of Auditor; and the proposition was carried.

Place of Next Meeting.

Mr. **Featherstone** moved that the next meeting should be held in Dublin.

Mr. **Tully** seconded the motion.

The proposition gave rise to a discussion, in the course of which the towns of Omagh, Drogheda, and Portadown were suggested. A show of hands was taken between Dublin and Omagh; and the result was in favour of the Metropolis by a large majority.

The **President** then delivered the following

INAUGURAL ADDRESS.

Gentlemen,—In addressing you for the first time as your President, I would make it my duty at the outset to thank you for the great honour you have conferred upon me, in a more emphatic manner than I felt able to do at the last meeting, when you elected me to this office. I can assure you of my high appreciation of your kindness. But I am not unmindful of the responsibilities and obligations attaching to the position. It is not an easy thing, in these days of Association meetings, to prepare an address to practical men, which shall contain any matter that has not already been rendered devoid of interest by its familiarity. This is especially difficult when the individual upon whom the presidential office is conferred is one whose time is completely occupied by the ordinary routine of gas-works management, and to whom little opportunity is afforded for making experiments, or for carrying out in practice those ideas of improvement which may have suggested themselves to his mind. I must therefore crave your indulgence if, in the course of my address, I am only able to deal with generalities, and do not present any new thing to your view, or throw more light upon topics which are now engaging the attention of the members of our profession. I promise to be brief, for two reasons—first, because I have nothing in the way of special novelty to bring before your notice; secondly because we have an excellent programme to get through

Although we have no fixed rule to the effect, it is gradually becoming the custom of Associations to hold their meetings at the place where the President for the time being may happen to be Manager. I should have been pleased to have followed in the wake of my predecessors, and to have welcomed you to Dungannon. But seeing that some of the members at our last meeting, in Newry, stated that "it was a round-about way to Dungannon," and preferred to have the meeting in Belfast, I cheerfully submitted to their better judgment. I allow that Belfast holds out more inducements to visit than my own town.

I am glad to be able to say that, financially and numerically, our Association is improving; our membership numbering 52. But though our progress has been marked and satisfactory, much improvement ought, in my opinion, still to manifest itself. There are many managers of small gas-works in the North of Ireland, who, from some cause or another, do not join us. I occasionally hear the statement that the managers of small gas-works need not trouble themselves about Associations, and the like. There could not be a greater mistake. The importance of lighting any town with gas cannot be measured by the size or extent of the place; and it is advisable that the gas supply of a small town should be as scientifically conducted as is supposed to be the case in the larger and more important ones. And is it not a fact that many of the managers of small works indulge the hope that some day their labours may be carried on in a more extensive field? With a view to fitting themselves for such extended work, I cannot conceive anything more desirable than that they should join our Association and contribute papers, giving all their difficulties and experiences, and noting carefully the discussions thereon, all of which will very materially assist them in their work. It is the desire of your Committee that the Association should be thoroughly representative; that it should be able to extend its assistance and usefulness to the managers of the very smallest works; and that they should, in return, add to the strength of the society by co-operating in all its various undertakings. Less than thirty years ago it was difficult, and considered to be a favour, for a manager of gas-works to be allowed to inspect the works of a neighbouring manager. Each one fancied himself to be the repository of a secret committed to his charge—a secret which was in almost every instance sacredly kept; and on each gas-works gate was the notice: "No admittance except on business." But, thanks to this and other kindred Associations which have been formed, this exclusiveness has been entirely done away with; and wherever we go, we now find inspection of works easy, and good feeling prevailing. These Association meetings afford gas managers the means of knowing what others are doing. Inquiries for information receive proper and full answers; and mental memoranda are made of successes and failures. To the manager of small gas-works, therefore, these organizations are invaluable and indispensable, inasmuch as, owing to the size of his works, he is precluded from testing many of the new patents and processes in this age of invention. At meetings similar to these, he comes in contact with some of his brethren in the profession, and is able to make their experiences his own.

The gas industry is steadily growing, and capital in gas-works is being largely added to. The "hue-and-cry" of the electric light has apparently helped to establish more firmly the financial position of town and provincial gas companies. It caused gas men to be up and doing. But the struggle is not over; for we shall again and again have some new and special form of electric lighting brought to the front by inventors and promoters. At present we have in the North and West of Ireland about eight or ten towns—some of no great magnitude—which are about to adopt the electric light. Our endeavours must continue in the direction of supplying the best article at the lowest possible cost; for, in the long run, consumers will weigh the different forms of lighting in the scale of, "Which is the cheapest?" and the system that answers this question most satisfactorily will be the one adopted. No doubt the electric light has a very great future; but this future will not interfere with the extension of the gas industry. And as in 1878 the cry was, "Electricity will be the light of the future," so now, in 1891, the cry is the same—it is still to be "the light of the future." It seems to me that, in the end, the electric light will be found to have been of service to gas companies rather than the reverse. On the one hand, a needed stimulus has been given to the improvement of the apparatus for burning gas; and, on the other hand, there has been created a demand for improved light, which we are in a condition to supply. The residents in large towns and cities especially will no longer be content with the modicum of street lighting which was considered quite satisfactory before the era of electric light experiments. Let the public be made aware that it is the local authorities, and not the gas companies, who are responsible for the street lighting, and that it rests with the former whether it shall be good or defective. Gas companies are able to supply light to any extent that may be ordered and paid for. No reasonable effort should be spared to secure the good-will of the general body of consumers. Since writing the above, I observe that the electric light has been introduced into Carlow by Messrs. J. E. H. Gordon and Co. The same Company have obtained the contract for lighting Larne; and water is to be the motive power. Of course, we shall have our eyes on Carlow, in order to see whether or not it will be more successful than Dundalk. I also notice that the same firm have obtained a contract from the Portadown Town Commissioners to light several of the leading streets in that town. The electric light seems, therefore, to be advancing. Well, be it so. There is room enough for both it and gas; and I am not, and never was, the least doubtful that gas would still "forge ahead," and its consumption increase.

It appears, from practical working, that there is not much to be derived from the Dinsmore process; and the various trials have proved to be a costly experiment to several parties. The only proper test I have heard of was in Liverpool, where they erected special plant for its trial—in fact, a complete gas-works, where they could carbonize 8 tons of coal per day—and handed it over to the Dinsmore Company, with coal of their own choosing, to do with it as they pleased. The Liverpool Gas Company paid all expenses; the only stipulation being that the gas should be tested by the statutory flat-flame burner, as used for testing all the Liverpool gas. The result was a failure; showing that there is nothing in the Dinsmore process that cannot be obtained by carbonizing coal in the ordinary way. When I first heard of the working of the process, through Mr. Isaac Carr, of Widnes, I had great hope of being able to dispense with cannel coal, and keep up the illuminating power of the gas to about 20 candles. But after the trial at Liverpool, my hope was blighted. All the trials of the process before it was tested at Liverpool were simply conducted in benches where only one oven or perhaps two were utilized for the purpose. Therefore nothing definite could be arrived at until complete plant was erected, as at Liverpool, and tested as it ought to be, by itself. The result has been a collapse. From information I have obtained, the cost of the settings of the Dinsmore process, utilizing all old materials, is about three times that of ordinary settings, besides the royalty of £2 per mouthpiece. As Mr. Mearns, of Banbridge, has had a bed of four retorts set on the Dinsmore plan, which was in use during the greater part of last winter, and has now another bed of the same number set on this system, which will be in use in the coming winter, he will have ample means, in the two ovens, of making all the gas required for his consumers, and will be in a position by next summer to say what are its merits or demerits. I was anxious that he should read a paper at this meeting, stating his opinions, and giving an account of the working of the process as he found it during the past winter; but he declined to do so. However, after another winter's trial of the process entirely by itself, he will be able to judge as to how far it bears out the assertions of its votaries; and he may then be induced to give us the benefit of his experience.

Inclined retorts seem to be coming to the front; and I believe all works of any magnitude will ere long adopt this system in part or entirely. The system has already been in use at Nine Elms, and Southall (London), Birkenhead, Burnley, Rochdale, and elsewhere. Of course, these are all large works; and I do not think the system will be of much benefit for small ones, as the first cost is considerable. The increase in the cost of manual labour in the carbonizing department opens up a field for the introduction of inclined retorts in large works.

We now hear very little about water gas; but only a year ago we were led to believe, from reports issued by the British Water-Gas Syndicate, that the manufacture of coal gas was doomed, and that water gas alone would shortly be adopted everywhere. An arrangement was entered into between the Water-Gas Syndicate and the Corporation of Harrogate to test the system. The experiment was to continue for three months; but before the expiration of that time, the plant and lamps were suddenly removed. A great many reasons for doing this were given; but as to which of these, or any other reason, is correct, the public are still in the dark. Of course, people can easily understand how it was that the experiment was tried at Harrogate, when they are made aware that Mr. Samson Fox, who is the moving spirit of the Syndicate, is, or was, Mayor of the borough. So that water gas has amounted to nothing, as far as lighting is concerned, up to now. I have no doubt that there is a field open for the gas otherwise than for illumination, whatever its projectors may do in the future.

It goes without saying that in most manufactories the price of the raw material governs the balance of profit; and a gas factory is no exception to the rule. Coal and cannel must be bought, and gas made, under all circumstances and at all times, whether it is produced at coal-famine rates or the reverse; and however deeply convinced a manager may be of the policy of supplying cheap gas, and however desirous he may be of doing so, present conditions are certainly not favourable to it. We have within the last twelve months experienced an unexpected rise in the price of coal and cannel—in the former to the extent of 3s. and 4s. per ton, and in the latter as much as 12s. and 13s. per ton; and the manufacturing cost of gas increased at once by about 1s. to 1s. 6d. per 1000 cubic feet, while the value of our residual products has not been enhanced. Consequently, the value of this extra charge falls upon the undertaking; and the question is, Will coal maintain the high price at which it stands? Probably we shall see some reduction in the cost. But there are no present appearances which warrant us in expecting a return of the rates which prevailed two or three years ago; and I believe some other means must be adopted, by those companies who are obliged to send out 20-candle gas to their customers, to bring it up to this standard, than the use of cannel coal. What a comfort it would be just now to those who are struggling under heavy cannel prices, if they could begin with confidence to use in a practical manner oil as a substitute. I believe Mr. Foulis, of Glasgow, as well as others, has been experimenting in this direction for some time; but, so far as I can learn, nothing has yet been advantageously arrived at. In my case, we have to use a certain percentage of cannel in order to have our gas of about 20-candle power; and the cannel which we could purchase, delivered free on trucks in Belfast, two or three years ago at about 18s. 6d. per ton, is this year 32s. 6d., or an advance of something like 95 per cent. Cannel coal masters are quite independent as to home orders, seeing that they have on hand more than twelve months' orders from the Continent and abroad for all they can raise. Retorts, bricks, and fire-clay goods of all kinds have considerably risen in price. These immense charges bear heavily on gas-works, especially those requiring a considerable percentage of cannel or other enricher; and large companies have had to resort to appliances for more economically handling material and producing gas.

It may be said that the easiest way out of the difficulty is to at once raise the price of gas to such a figure as will cover our diminished receipts; and if we were to follow the example recently set by one or two of the largest gas undertakings, I fear such increase would soon become general. I am of opinion that this is the very last step a gas company should take, and that, before the charge is put up, every other method likely to popularize the use of gas and residual products, and thereby augment the consumption and the company's revenue, and enable them to meet their additional liabilities, should be resorted to. I would also draw upon the reserve fund and the floating balances, when available; and would in every possible way utilize all resources before raising the price to the consumer, as I believe an increased price not only means diminished consumption, but, in these days of keen competition, it would give our competitors an advantage of which they would not be slow to avail themselves. But, on the other hand, I doubt if the public desire gas companies to keep their price so low that the margin of profit would not enable them to pay their shareholders a reasonable dividend. No doubt people want cheap gas; and I think no one will deny the fact that, for some years past, they have, in the majority of cases, had it. Should, however, circumstances, such as an advance in the price of coal, labour, and material, over which gas companies have no control, place them in the position of having reduced profits that will not enable them to pay their shareholders' dividends, and it is clearly put to the public that, before asking the consumers to bear any portion of this enhanced cost, they had utilized all the resources at their command, I believe the public would pay, with as good a grace as possible, any small additional charge which it might be found necessary to make.

Other important rivals to coal gas are the various oils now consumed for lighting and heating purposes by a large number of householders, who prefer to use these dangerous materials, through which so many lives are sacrificed, either by explosion or careless handling. With oil at 7d. or 8d. per gallon, and the immense variety of elegant, useful, and cheap lamps now to be obtained, one cannot wonder at its popularity with the working classes, while so many obstacles to the use of gas stand in their way. We have also instances of town commissioners, when they cannot get gas for less than cost price from the local gas companies, immediately resorting to the use of oil-lamps for street illumination. But these have invariably proved to be miserable failures. The popularity of gas can only be maintained and increased so long as we can prove to our customers that it is not only the cheapest, but the most convenient for artificial lighting and heating.

Prepayment meters have not gained popularity with the class of consumers they were intended to benefit. They must require a great deal of attention. The consumers argue that the gas is costing them from 1s. to 1s. 2d. per week, in place of 4d. to 6d. for oil; and they do not appreciate the better and safer light. Several people have not worked the handle of the meter properly; and they have therefore lost their pennies—vowing vengeance on the meter, in consequence.

The Claus system of purification in closed vessels, as in use in Belfast, has not been fully successful; and though no information has been given publicly, it has oozed out that the plant erected was incompetent to purify entirely the large quantity of gas required to be dealt with. I believe they have been altering the plant during the summer, and possibly after another winter we may be able to hear that purifying gas in closed vessels has been a success.

An element of a disturbing character is to be found in the unsettled relations between employers and their workmen; and several gas-works have been directly affected thereby. But in the district covered by this Association, there are a large number of small works, so that the labour question is not of such vital personal interest as it is on the other side of the Channel. Yet the infection is catching, and it may spread. I hope, however, in the interest of capital and labour alike, some method of settling such industrial disputes may be adopted other than strikes, of which, during the past year or two, we have had so many deplorable examples. I trust the Royal Commission which is now sitting to inquire into the whole labour question will adopt a method which will provide for the arrangement of labour disputes without having recourse to open rupture.

In passing, I may just mention that the South Metropolitan Gas Company, of London, are about to put up a gasholder which, when finished, will be the largest in the world. It is to be in six lifts, and will be capable of containing 12 million cubic feet of gas. I think there is great boldness displayed in erecting a holder of such dimensions; and, personally, I would give it a wide berth during a hurricane.

I would recommend those managers who wish to open a field for the sale of sulphate of ammonia to carefully peruse the paper read at the last meeting of The Gas Institute by Mr. T. N. Ritson, of Jersey, as it is a most interesting and useful contribution to the literature of the subject.*

I think I must have pretty nearly exhausted your patience, while travelling over these well-worn tracks; and therefore I will now close. While I must congratulate you on the growing strength of the Association, I greatly fear our Secretary has some difficulty in procuring papers for discussion at our meetings. I wish there was less diffidence among our members in coming forward with subjects. What is required is not so much a long paper, taking up a considerable amount of time in its preparation, but merely the introduction of some of those points of interest connected with our business which are calculated to lead to friendly discussion. We should be learners—gladly welcoming every help, and respecting every personality. But we should also respect our own, and bear in mind that, though the wide Universe is full of good, no grain of nourishing corn can come to us but through the labour we bestow on the plot of ground which is given to us to work. To undervalue our own thought because it is ours—to depreciate our own powers or faculties because someone else's are more ingenious—to shrink from doing what we can because we think we can do so little—is to hinder our own development and the progress of the world; for it is only by exercise that any faculty is strengthened, and only by each one putting his shoulder to the wheel that the world moves and humanity advances.

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* See *Journal of Gas Lighting*, Vol. LVII., p. 1304.

And now, gentlemen, in conclusion, I have only to thank you for having so patiently listened to these desultory remarks. I only hope the papers to be submitted to you may meet with full, frank, and courteous discussion, so that the chief object of our meeting to-day may be realized—namely, improvement in the knowledge and practice of our profession by the mutual interchange of experience.

On the motion of Mr. STEARS, a hearty vote of thanks was accorded to the President for his address.

The PRESIDENT briefly expressed his acknowledgments.

Mr. D. WILLIAMSON (Ballibay) read the following paper:—

SHOULD THE SUPPLY OF GAS BE IN THE HANDS OF COMPANIES OR CORPORATIONS?

Mr. President and Gentlemen,—The subject I have chosen is one which I think is worthy of the consideration of every gas manufacturer and consumer, more especially if it can be made clear, by its intelligent discussion, that the public can be supplied with gas more economically by the service being in the hands of one or the other body. I think, therefore, that the question comes naturally within the scope of an Association like ours; and in a meeting such as this, when representatives of both classes of proprietors are present, it can be discussed from the two standpoints. Seeing that, as gas managers, the interests of the consumers are ours quite as much as those of the proprietors, I believe the discussion will be an impartial one. I may say that I have never heard the subject debated; and for this reason I have attempted to bring my own ideas on the matter before you now, though in a rough and very imperfect manner; trusting a thoroughly exhaustive investigation may be the result.

At the outset, I must say that my own views on the question are very decided. I have thought a great deal about it, and am fully convinced that it would be to the advantage of gas consumers generally to have the supply under the control of the existing local authorities, or, perhaps still better, county boards. I am a believer in a minimum of capital with a maximum of shareholders; for I hold that the greater the number of shareholders, the greater the sympathy in any concern. Now, I need not say that this would be fully realized if the gas-works were transferred from companies to local or county boards. I do not wish it to be understood that I find fault with gas companies generally, for I do not. I believe that they have served their customers fairly well; at the same time, I think that local or county boards could do it better.

It is said that there are £130,000,000 sterling sunk in the gasworks of England, Wales, Scotland, and Ireland. It is computed that £30,000,000 of this capital is under the control of corporations; leaving the remaining £100,000,000 in the hands of companies. Now, if we look over the returns given in the "Gas and Water Companies' Directory," we find that the dividends paid by gas companies to their shareholders are: In England, from 2½ to 17 per cent.; in Wales, from 2½ to 12 per cent.; in Scotland, from 2½ to 15 per cent.; and in Ireland, from 2½ to 10½ per cent. It would seem from these figures that, of British gas companies, those in Ireland yield the smallest return to their shareholders; and I think I shall be pretty near the mark if I assume the average dividend paid in this country to gas shareholders to be 6 per cent.

It is well known that local boards can borrow money from Government at a much lower rate than even 5 per cent., which rate covers not merely the interest, but the repayment of the principal in a certain number of years. If we take it at 5 per cent., £100,000,000 at 6 per cent. would be £6,000,000. Now, supposing all these works were bought by the local or county boards at this full amount of capital of £100,000,000, borrowed thus, and repayable in a certain number of years at 5 per cent., there would be a net saving of £1,000,000, which could go towards reducing the price of gas. There would also be the advantage that, at the end of the given period, the works would be the property of the boards, free of any annual charge whatever.

To explain more fully my meaning, I will take a small works in Ireland with a paid-up capital of £2000, at 6 per cent. dividend, which would be £120. Supposing this was purchased by the local or county board at the full amount of £2000, repayable at 5 per cent., there would be a net gain of £20 per annum for the stipulated number of years over which the repayments of the loan would extend, and the additional saving of the £100 a year besides. But I shall now content myself with looking at the immediate saving of £20. There would then be no need for the services of a secretary or collector, for this duty could be transferred to the clerk and collector of the board; and I should estimate a net gain of £15 on this account. Directors' fees would also be saved—say, £15. This would make a total of £50 at least in favour of the transfer. I take the receipts for gas from such works at £500 per annum (there may be some more, but I am sure there are some less). This would show a saving equal to about 10 per cent. of the gas receipts; and if the price were 6s. 8d. per 1000 cubic feet, it would allow of a net reduction of at least 8d.

One great advantage arising from the transfer would be that all the ratepayers in the place, either directly or indirectly, would be shareholders in the concern; and this would have a tendency to increase the consumption of gas. This is much wanted in all our small towns; as, of course, the limited number of the consumers, and the small extent to which they use gas, prevent it being supplied at a cheap rate, especially in inland places, where carriage is such a heavy item in the expenditure. Another advantage would be that there would be fewer, if indeed there were any, of those unpleasant disputes with which I am sure that some of you are acquainted. Under the present conditions, it too often happens that town commissioners complain that the gas company charge far too high a price for the gas supplied to the public lamps; and they demand a reduction. Sometimes they go so far as to name their own price; thus intimating that they consider they know the directors' business better than they do themselves—a proceeding which generally ends in a rupture, and the gas being cut off from the public lamps and oil substituted. Truly a miserable change! I have known this to be done for at least three seasons, to the great displeasure of all the ratepayers. But, of course, they then returned to gas. I need not say that this would not occur if the change I advocate took place.

The next consideration is how this transfer of property is to be accomplished. This is a difficulty in connection with the subject which I confess my inability to solve; but I will give you my idea, and leave it to more competent authorities to complete. Perhaps some will say that the law as it now exists is quite sufficient. I think it is not; and for this reason: It seems to me to be a piece of very rough and slow legal machinery, which is compulsory on one side only; for, if I mistake not, while it compels gas companies to sell, it does not compel local boards to buy. What I think is required is a short Bill, to be called (say) the "Gas Companies' Compulsory Transfer Bill;" or a clause for the purpose might be inserted in a County Council Bill.

Then with reference to the price that should be paid to the companies, I would say: Give them not more than 20s., perhaps less, for every £1 of paid-up capital that is sunk in the concern. Someone may remark that this would be treating the gas shareholders unfairly, as they are receiving good dividends for their money. My reply is: They are not entitled to more than a fair return for their money; and if they receive a large dividend, they should not do so, for the company ought rather to reduce the price of gas and give their customers encouragement to extend its use for other purposes than illumination—such as for heating, cooking, &c.

There is a further benefit which I think would arise if the county boards had the gas-works transferred to them, and that is that the boards could purchase, under one contract, all the coal, &c., required for the different works under their control. Thus the small works would be supplied with as good material as the large ones, and at the same rate. This, I think, would be an undisputed benefit, especially to small places.

It may be urged that I am not justified in asking the farmers of a country to be responsible in any way for a guarantee for something that is only in the interests of those who reside in towns. My reply is: "What is sauce for the goose is sauce for the gander." The farmers are no more entitled to ask the ratepayers of a town to be responsible for a guarantee for the repayment of their holdings. Therefore, the course I propose would be asking nothing more from country ratepayers than they now receive from town ratepayers; and I think there is nothing unfair in this. But some may say that only consumers of gas would be benefited by the change. I reply that most certainly consumers of gas would be benefited by it; but I contend that every ratepayer would be benefited as well. They would do so in two ways. First of all the streets would be much better lighted, at a lower cost for gas; secondly, they would have the advantage of the works becoming their property, free of charge, at the end of the period for repayment; and then the gas could be supplied at a cheaper rate.

I have endeavoured, in my own rough and imperfect manner to show you that gas can be sold at a lower price, by at least 3d. to 8d. per 1000 cubic feet, by the change of control of the different works from companies to local or county authorities. I hope this will soon be an accomplished fact; for I believe that gas should be supplied at the lowest possible price consistent with the keeping of the works in proper repair. In fact, I would say that it should be sold like any other commodity that is dependent on a fluctuating market for its raw material. I mean that if coal is bought at a low price, the charge for gas should be correspondingly low; if the price of coal rises, that of gas should be raised accordingly for the time. The price should always be regulated in proportion to the cost of coal, labour, &c.; and I have no hesitation in saying that local or county boards could do this with much less difficulty than a company would experience. I need not say that it is a pleasure to give notice of a reduction; but the very reverse is the case when an increase has to be intimated.

These are my views in regard to the proper parties to have the control of the gas supply of the country; and if I have said anything that will arouse an expression of opinion, adverse or otherwise, I shall be pleased to hear it, either in this meeting or anywhere else. I really think gas consumers all over the country should consider this matter, as they would all be benefited by the change I propose. You are all aware that it is in the hands of the ratepayers to make a general transfer of gas-works to local authorities an accomplished fact, as it is they who would be benefited thereby.

Having the utmost faith in the proposal I have made, I hope we shall soon see it carried out. If this were done, it would have a tendency to equalize the price of gas all over the country. If any of you go to the trouble of looking into the statistics bearing upon the matter, you will be much surprised to see the great difference in the price charged for gas in towns which are about equal in size and position. I will give you a very few places I have grouped together in this way, and you will observe the great disparity. The works in these towns all belong to companies, except two (marked with a *), which are owned by private parties :—

Town.	Tons of Coal Used.	Price Charged.	Difference.
Omagh	—	5/-	1/3
Tipperary	—	6/3	
Banbridge	800	3/9 to 4/7	3/9 to 2/11
*Mullingar	800	7/6	
Monaghan	550	5/10	0/8
*Enniskillen	800	6/6	
Donaghadee	115	5/-	2/11
Ballyshannon	120	7/11	
Galway	1,600	4/9	0,8
Sligo	1,700	5/5	

Now, a glance at the map of Ireland will show that each two of the places I have grouped are pretty nearly similar in size and position, and yet there is a great difference in the price charged for gas, especially in the cases of Banbridge and Mullingar, and Donaghadee and Ballyshannon. I think that such a difference should not exist; and I believe that if the supply were in the hands of the local or county authorities of those towns, it would not exist. Again, in looking over the Directory already alluded to, I was surprised to see that so few gas-works in Ireland are under the control of local boards. I think there are only about seven or eight in the whole of Ireland in the hands of these bodies. So I have taken a few of them and compared their prices :—

Town.	Proprietor.	Tons of Coal Used.	Price Charged.	Difference.
Bandon	Commissioners	700	5/-	1/3
Carlow	Company	700	6/3	
Coleraine	Commissioners	1,200	4/2	10d.
Queenstown	Company	1,530	5/-	
Newtownards	Commissioners	943	4/2 to 4/7	1/3 to 10d.
New Ross	Company	900	5/5	
Youghal	Commissioners	705	5/-	2/6
Ennis	Company	760	7/6	
Newry	Commissioners	3,115	4/2	6d.
Waterford	Company	4,278	4/8*	
Belfast	Corporation	91,926	2/9†	9d. to 1/3
Dublin	Company	117,614	3/6 to 4/-	

* Net. † Less discounts up to 20 per cent.

From these figures, I think you will see that what I have endeavoured to prove is a reality, so far as regards the price charged for gas in those places which are under the control of the local authorities, when compared with places of about the same size and position under the control of companies. I am sure you will agree with me that, if Belfast can supply gas at so low a price, that of Dublin should surely not be so high, especially since the Dublin Company, according to the figures given, carbonize 25,688 tons of coal more than the Belfast Corporation. But I think that this difference is caused by the change of ownership in Belfast from a Company to the Corporation. I consider that the ratepayers are very much indebted to the Corporation for their forethought in the purchase of the gas-works; and that Mr. Stelfox and his subordinates are worthy of the thanks of all the gas consumers in the city for their economical management of the gas-works, when they can be supplied with gas at so low a rate as that which I have given. Of course, there is only one Belfast in Ireland. But I believe if the principle adopted there were carried out all over the country, it would result in a benefit to the gas consumers generally of from 3d. to 8d. per 1000 cubic feet. So that I think consumers should look to this for their own advantage; for they would certainly effect an immediate saving, as I have said, of 10 per cent. or more on their gas accounts.

I have endeavoured to place before you, in a simple way, my views on this question, supported by facts and figures which I believe to be indisputable; and I shall be pleased to hear you all express your opinions on the matter. I know that you will not all agree with me in my conclusions; but a healthy discussion will do good. For my own part, I have the greatest faith in the benefit that would result if my ideas concerning the gas supply of Ireland were to become accomplished facts.

Discussion.

The PRESIDENT said Mr. Williamson had placed the Association under a debt of gratitude by preparing and reading so admirable a paper. The subject treated was one that he (the President) had never heard dealt with before. The speaker had put his views before the members in an able manner; and he was sure the subject would give rise to a useful and profitable discussion.

Mr. FEATHERSTONE suggested that the views of Mr. Valon, from his position as President of The Gas Institute, would prove interesting to the meeting.

The PRESIDENT said the members would be delighted to hear Mr. Valon, if he would be good enough to address them.

Mr. VALON said he had not expected that he would be asked to speak at the meeting; but he would be glad of the opportunity of making a few remarks upon the subject dealt with in Mr. Williamson's paper. However, in order to be in a better position to do so, he would like to postpone his observations till those who desired to discuss the question had placed their views before the members.

Mr. SALMON expressed his admiration of the manner in which Mr. Williamson had treated his subject; but he said he could not agree with him in the conclusions at which he had arrived. In his opinion, consumers were far safer in the hands of a company carrying on their business under the watchful care and supervision of town commissioners or a corporation, than they were when the gas-works were managed by these authorities. He thought the consumers were much more fairly treated by a company than by a corporation, because, in the case of the latter, there arose the question of the division of the spoils; and the paraffin man claimed his right to get as big a share of the profits as anyone else. Another argument in favour of his views was that, if the gas company were not in any way dependent for privileges on the town or city board, it would be found that they would extend their system considerably beyond the limit that would be observed if the lighting were in the hands of the local authority. This was his experience of both companies and corporations; and he had come to the conclusion that, as far as the interests of the consumer, at all events, was concerned, they were much safer and better off where the works were in the hands of a company than where they were under the control of a corporation. One great objection he had to gas-works managed by corporations was that these bodies changed their minds so often with regard to the management. In fact, changes in the control of the works seemed to be their principal hobby. The man in charge was sent about his business, and another was brought in, with the result that, in the great majority of instances, the new man discovered that everything had been going wrong under his predecessor, and changes were the order of the day. In his (Mr. Salmon's) opinion, what was required in a great many cases was that a travelling engineer should be appointed to look after the plant—a course which he believed would be attended with most satisfactory results. These and many other things that had come under his observation from time to time, led him to the conclusion that a company gave a better and a cheaper light than a corporation, and that in every way the interests of the consumer were more satisfactorily conserved and looked after by a company than they would be by a local authority, whether town commissioners or a corporation.

The SECRETARY remarked that the Association were deeply indebted to Mr. Williamson for his paper. This was a subject which was bound to raise discussion, and upon which it could hardly be expected that they would all be of one mind. One thing, however, must be quite clear to every one, and that was that Mr. Williamson had certainly the courage of his convictions. He had given them a great many figures in support of his arguments; and he (Mr. Whimster) had just been considering them. They had all heard it said that figures could be made to prove anything; and Mr. Williamson had made very good use of the figures he had cited to establish the position he had taken up. Figures, however, could be quoted that would very considerably shake the arguments of Mr. Williamson. He (Mr. Whimster) could point to one instance of an inland town where the gas-works were in the hands of a company, and where the gas was sold considerably cheaper than in a seaport town where the works were under the control of a corporation. He could not agree with Mr. Williamson in what appeared to be his view of the question—viz., that the gas supply being in the hands of corporations was the *El Dorado*—the Land of Promise of the future. Corporations were fluctuating bodies, composed of men who were elected to a coveted position; and when these men reached the goal of their desires, and found themselves representing the public on these bodies, they felt bound to justify the confidence that had been reposed in them by the votes of their fellow-citizens. It was their object to gain popularity; and there were different ways in which this was accomplished. The two principal, and perhaps the two easiest ways of justifying this confidence, of increasing their popularity, and of raising themselves in the public esteem, were, first of all, the reduction of taxation; and, secondly, the reduction of the price of gas. Under such circumstances as these, whenever a corporation had a surplus, the members dealt with it in one of two different ways. They took the surplus away from the original purpose for which it was intended, and devoted it either to a reduction of the general taxation, or to the lowering of the price of gas to such an extent that, as a necessary consequence, the works would have to be starved in order to be in a position to pay their way at all. Under such circumstances, and with such a course of action, it was not hard to see that the result was a large expenditure, the capital account swollen to a terrible extent, and the concern burdened for the future. In the case of a company, the proprieters had a direct pecuniary interest in the undertaking, which the members of a corporation, either individually or collectively, did not possess. Any surplus which might be the result of the working of a company was conserved for their future needs; and this surplus eventually helped them to tide over times of difficulty and danger, to keep their plant well to the front in every way, and, in the matter of repairs and improvements, to make the works equal to the demands they might have to meet. Under these circumstances, a company possessed that important *desideratum*—a moderate and uninflated capital. The subject was, as he had said, one upon which there was sure to be a great deal of difference of opinion. They could not be all corporation men, neither could they be all company men; and they all had their own ways of looking at this question, which he was glad Mr. Williamson had brought forward.

Mr. Stormonth thought that, after the fierce onslaught which had been made upon the reader of the paper, it was time someone came to his assistance. One thing struck him in connection with the paper and the remarks it had elicited, and that was that Mr. Williamson had not made a single abstract statement; whereas, in his (Mr. Stormonth's) judgment, their worthy Secretary had made a number of them. Mr. Williamson's contention was that the interests of consumers were safer in the hands of corporations or town commissioners than they were in the hands of companies; and he had supported the position he had taken up by facts and figures which could not be controverted. It was all very well for Mr. Salmon to say he was sure that consumers were better and more fairly treated by companies than by corporations; but had he produced a single fact or figure to prove the truth of his assertion? No; he merely made the statement, and adduced nothing in the shape of statistics in order to convince them that his view was right. What the consumer wanted was cheap gas; and all the consumer was concerned about was the amount of his bill at the end of the quarter. He wished it clearly understood that he did not endorse all the opinions Mr. Williamson had expressed in his paper—in fact, there were several statements with which he could not possibly agree for a moment. For instance, there was the Bill which Mr. Williamson had suggested; and he (Mr. Stormonth) could only characterize the idea as a most remarkable one. He did not anticipate that any member of Parliament could be induced to take it in hand; but if one was found who was foolish enough to do so, he would be laughed at, and deservedly, by all common-sense men. With regard to Mr. Salmon's statement, that a corporation or a board of town commissioners would not carry their lighting system beyond a certain limit, he thought that gentleman was labouring under a mistake. He (Mr. Stormonth) was under the impression that they were bound to do it. For the purposes of his argument, Mr. Williamson had compared Coleraine, the town with which he (Mr. Stormonth) was connected, with Queenstown. Now, although Queenstown was a much larger place than Coleraine, the comparison was most favourable to the latter. Geographically speaking, both places were very similarly situated; and while in Queenstown gas was sold at 5s. per 1000 cubic feet, the rate in Coleraine was only 4s. 2d. (with discounts ranging from 5 to 10 per cent.). For this amount, good gas of 18-candle power was supplied to the public; and the works were not in any way starved. He did not for a single moment deny that, under a corporation, there was a danger of the members mis-appropriating surpluses, by devoting them to other purposes than that for which they were originally intended. But, speaking of his own Board, the Coleraine Town Commissioners, he should say that, although he did not agree altogether with the policy of the Commissioners, it was a very wise one after all. Their policy was to reduce the capital as far as possible. Last year his works turned out 13 million cubic feet of gas; and they were as good as those to be found in any place of similar size.

Mr. Tully inquired what was the original capital expended on the Coleraine works.

Mr. Stormonth replied that this was a question which he was not in a position to answer. He might say, however, that the works were built in 1845 by the Town Commissioners.

Mr. Tully said that, when a corporation obtained possession of gas-works, they rebuilt them altogether; and, of course, they were then in a position to carry them on more economically. Speaking of his own works at Sligo, he found them in a state of dilapidation. There was a leakage of 65 per cent.; and he could not purify the gas. If the exhauster was stopped, the gas went out at the hydraulic main. He had no scrubbers; and the plant generally was in a state of complete wreck. Of course, they had first of all to set to work to put the place in order; and the Directors raised £2000 on mortgage—stating that they could not give him any more. They at once went ahead, and spent £4000. They substituted a steam-engine for the old gas-engine, put in scrubbers—in fact, remodelled the place altogether; but, even with what had been accomplished, he should consider that he had done good work if he brought the place into form in five years' time. The advantage possessed by corporations in the matter of gas supply was that they had plenty of money with which to put their works in order and keep them so.

Mr. Waddell said that what struck him most forcibly, when listening to Mr. Williamson's paper, was the figures he had quoted to support his arguments; and it appeared to him (Mr. Waddell) that they must refer to some years ago. He could, however, speak with certainty about his own works at Newtownards; and the figures given by Mr. Williamson with regard to them were incorrect.

Mr. **Williamson** explained that he took the figures from the statistics for 1890.

Mr. **Waddell** said he did not supply any figures with reference to his works. However, on the broad question, there were many instances that could be used as arguments on both sides; but, as a general rule, he thought a local body representative of the people, such as a corporation or a board of town commissioners had a little more sympathy for the public than a company. Speaking of his own town, the comparison of the works before the Town Commissioners obtained possession of them, with the condition they were in now, was very much in favour of the Commissioners. Previous to the transfer, the charge for gas was 6s. 8d. per 1000 feet, with a rent of 4s. a year for meters, whereas now it was 4s. 2d. and no meter-rent; and when percentages, &c., were taken off, the charge was brought down to something like 3s. 7d. to the larger consumers. This looked very well for the Commissioners; but the same men who had formerly been connected with the management of the Gas Company were now members of the Board of Commissioners.

Mr. **Salmon** agreed with Mr. Waddell that the figures given by Mr. Williamson must be old, as they certainly did not correspond with the true figures in some cases with which he was himself acquainted.

Mr. R. **Merrilees** (Castleblaney) thought it would have been of great assistance to the members in considering this matter if they could have had before them the price of coal in the different places alluded to in the paper, and the cost of its carriage.

Mr. **Williamson** said he could not give information of this character.

Mr. **Tully** considered it would have been an advantage if Mr. Williamson could have given a short history of the gasworks in each of the towns to which he had alluded.

Mr. **Williamson** said he had furnished all the information with regard to the different places that he could possibly obtain. As to the figures he had cited, the accuracy of which had been questioned, all he had to say was that he obtained them from the statistics for 1890, which were the only ones at present available.

The SECRETARY, referring to the statement of Mr. Waddell that he did not supply any figures, said that, if managers did not send in their statistics, they must take the consequences.

Mr. VALON said the question raised by Mr. Williamson's excellent paper, which had been so ably discussed by the members who had spoken—namely, as to which management was best, that of a corporation or that of a company—was a very vexed one among gas men. It at once resolved itself into two parts—first, were the consumers better off; and, secondly, were the managers better off? The interests of the consumers and the managers did not always run together; and the question had therefore to be considered in a twofold aspect. It was possible for the manager to be well off under a corporation, and the consumers to be badly off, and *vice versâ;* and the same remarks applied to consumers and managers who were under the control of companies. In considering this question, they must start, in the first instance, with the conviction that there was something to be said on both sides. In certain cases, the consumers were better off under corporations; in others, under companies. It was the same with managers. He was a corporation man; but he was also a company man. He was engineer for both corporations and companies; and at Ramsgate (his own place) he was under the Corporation, who had control of both the gas and the water supply. This being the case, he thought they would allow that he was in a position to look at the subject from an impartial and unprejudiced point of view. They should not, in trying to do justice to corporations, at the same time do injustice to companies; neither, on the other hand, should they, in trying to be just to companies, be unjust to corporations. He knew certain companies—perhaps it would be better not to mention names, but he could do so if the members desired it—that served the consumers quite as well as it was possible for any corporation to do. Speaking only of England, because he did not know much about the economy of things in Ireland, he thought it must be admitted that corporations, as a general rule, served their consumers better than companies. They all knew that the former made large profits; and these were dealt with sometimes judiciously, at other times injudiciously. It should be remembered, however, that where works were erected and controlled by a corporation, the rates were made responsible for the cost both of erection and maintenance; and therefore, while it was fair that the consumer should get his just share of the profit, it was not fair that he should get it all. Under such circumstances, the profit should, with all justice, be fairly divided between the consumer and the ratepayer. The ratepayer was certainly entitled to something, because, in case of a loss in the working, it would fall as a charge upon the rates. It did not, therefore, require any argument to prove that it was right and just that the ratepayer was entitled to consideration in the division of any surplus or profits resulting from the works. He had in his mind instances of corporations who dealt with their profits in this equitable style: The gas was sold at a fairly low price; and at the end of the financial year, the balance of profit was fairly divided between the consumers and ratepayers. To take a case, let them suppose that, at the end of a year's working, a corporation had from their gas-works a profit balance of £5000—any figure would do; but let them take £5000. In dealing with this sum, half of it would be given to the district rate or other fund for the benefit and relief of the general rate upon the community; and the other half returned to the pocket of each of the consumers, in proportion to the quantity of gas consumed during the year. In his opinion, this was the fairest and most equitable way of dealing with the profits of any gas-works controlled by a corporate body. Was it a just thing to find a corporation transferring the entire profits of the gas undertaking to such purposes as the improvement of the city and the erection of large halls and other buildings? Speaking for himself, he did not think it was. He considered that this was not the proper way to dispose of the profits resulting from the corporate management of gas-works. Speaking of the interests of the consumers, he believed there could be very little doubt that, as a general rule, they received more benefit, and were generally better off, under a corporation than they were when the supply of gas was in the hands of a company. With regard to Mr. Williamson's suggestions as to the transfer of gas-works from companies to corporations, there could be no disputing the fact that it would pay corporations very well if the companies could be induced to come forward and say they would consent to the transfer of their property at the very lowest possible cost. He remembered one case in which a corporation bought the gas-works from a company, paying the latter for it from £180,000 to £200,000, which was at the rate of eight times the original invested capital; and notwithstanding this very large sum, the corporation, on gaining possession of the property, were able, in the course of time, to re-construct the entire works, reduce the price of gas, and at the end of every year to leave a large margin for the benefit and relief of the general rates. This was a case with which he was personally acquainted—

one in which the corporation concerned were dealt with by the selling company as hardly as possible; and still they were able to do all he had stated. So much for the question of the interests of the consumers under corporations and companies. He now came to the consideration of the second branch of the subject—namely, the management. In discussing the question as to whether managers were better off under corporations or companies, he must again remark that there was something to be said on both sides. In his own experience, he had known careless directors of companies and careless members of corporations; and, on the other hand, he had met directors and corporations who were most zealous in the discharge of their duties, and in looking after the interests committed to their care. Speaking first of all of corporations, the difficulty with regard to them was that they were a shifting body. They might get a very good man whom they desired to keep; but they could not, and he would go away. Then, again, they might get a very bad one—a man who was always meddling and interfering at the wrong time and place; and they would desire to get rid of him. But here again they failed; and the objectionable man remained on. It should be remembered that they had to deal with a man as part of a body, not as an individual. There were men who sought positions on corporations, actuated by a desire to do some good for the public; and therefore they should give them credit for the best of intentions. As a general rule, men who came forward with honesty of purpose usually succeeded in the end. To sum up his experience, he thought that, where a gas undertaking had been fairly purchased, properly conducted, and the manager enjoyed full and legitimate freedom, it could not be disputed that works which were controlled by the representatives of the public in the interests of the people, must be much better than those controlled by a company primarily in their own interest.

Mr. **Williamson**, in reply, thanked the different members who had spoken for the complimentary terms in which they had referred to his paper, and he expressed the pleasure he felt at the useful discussion which he had opened. Remarks had been made with regard to the accuracy of his figures; and in this connection, he desired to say that he had no very great interest in the selection of the figures to support his arguments. It was through the kindness of Mr M'Callum that he had been able to quote the particulars from the statistics of 1890. He had been greatly struck with the comparison of the price of gas under corporations and companies; and it proved to him that benefits were to be derived from corporate management that could not be obtained from companies. Corporations had no dividend to pay; and therefore the money went to the reduction of the price of gas. With regard to the remarks of the Secretary, if any gentleman could speak with authority on behalf of companies, Mr. Whimster could. In Armagh that gentleman supplied the consumers with gas at a very cheap rate, considering the circumstances under which he had to work, and the difficulties with which he had to contend. When he (Mr. Williamson) advocated the purchase of gas undertakings by local authorities, his reason was that the capital would be reduced in this way. The money which would otherwise go to pay the dividend would be more than sufficient to meet the instalments of the sinking fund; and in course of time, the works would become the sole property of the ratepayers. He thought Mr. Valon had put the matter very fairly before the meeting; and he was glad that a gentleman whose opinions were entitled to such weight and attention, was in favour of the corporate management of gas undertakings.

The next item on the *agenda* was a paper entitled "Sketches of Furnaces, and Utilization of the Waste Heat," by Mr. W. B. Featherstone; but it was explained by the Secretary that this gentleman was not in a position to read it.

Mr. T. Frizelle (Holywood) then read the following paper:—

THE MANUFACTURE OF SULPHATE OF AMMONIA IN SMALL GAS-WORKS.

As the present is a rather critical time for small gas-works, principally owing to the advance in the price of coal and the competition of other illuminants, I have thought that a few words in regard to working up some of our residuals might be acceptable, by bringing under your notice a source of revenue from what may at present be a nuisance, or at least a difficulty to get disposed of—I mean, of course, ammoniacal liquor. Now, I am acquainted with small gas-works where the managers find it hard to know what to do with their liquor. They are at a considerable distance from chemical works, and they have no plant for treating the liquor themselves. Besides, the railway rates are so high that some of the chemical companies will scarcely pay carriage on it, although they have it pumped into barrels free of cost. Unfortunately, our farmers and market gardeners are not aware of the great value of it to crops, or of the amount they pay for it when purchasing it mixed n chemical manures.

I believe the first cost of the apparatus deters a good many managers from embarking in the manufacture of sulphate of ammonia. A few words regarding the way in which I went about getting up a small plant may, therefore, be of service to the uninitiated. About two years ago, seeing that coals had a tendency to advance in price, I was anxious to make up in some measure, if possible, the extra expenditure thus entailed; so I decided to try the manufacture of sulphate. I wrote to different makers of plant, giving the quantity of coals carbonized per annum, and other particulars. The prices quoted were very high for small gas-works; but I have no doubt the apparatus was good. However, I visited a few works where sulphate manufacture was carried on; and I must here acknowledge my indebtedness, among other gentlemen, to our worthy President (Mr. Ross), and also to Mr. Nisbet, of Portadown, who were very kind in answering all inquiries. On my return, I decided to collect the materials for plant, and obtained a second-hand steam-boiler to act as a still. As I required a settling-tank, I purchased a ship's water-tank which holds upwards of 1500 gallons. The saturator, 4 ft. by 4 ft. and 3 ft. deep, is made of 2½-inch plank firmly bolted, and lined with pure chemical lead, 14 lbs. to the square foot—the joints being all burned by a lead burner (it was constructed under my own supervision); also a draining-table 4 ft. by 4 ft. 6 in. and 6 in. deep, covered with 6-lb. lead; and a salt store. This is a corner of the sulphate-house floored with 1½-inch timber 12 ft. by 6 ft., and sheeted 5 ft. high round the wall with ¾-inch sheeting. The floor is covered with sheet lead, 4 lbs. to the square foot, and has a fall to one corner, where a small tank is placed to receive any liquid draining from the salt. Wood sheeting is laid on the salt store floor, as sulphate does not dry well on lead; besides, the shovel would cut the lead if it were not covered.

The sulphate-house is part of the purifying-shed partitioned off; and it adjoins the retort-house, where the still is built in an old single-retort bed. The flue from the still is carried into the retort-stack; and the sulphuretted hydrogen from the saturator is also conveyed into the main flue and burned. Lime is let into the still through a little tank in the shape of a wet-meter case. A jet of steam is connected to the still, for the purpose of agitating the liquor after the lime is let into it. The steam also assists in driving off the ammonia. A catch-box is placed between the still and the saturator, to prevent any liquor from flowing into the latter. This catch-box is an ordinary gas-well or syphon-box. The settling-tank is erected in the yard, at an elevation to command the still; and a 3½-inch Archimedean pump is used to raise the liquor from the tar-well into the settling-tank. The whole apparatus cost less than £53; and up to the present time it has required no outlay for repairs.

Now with regard to the result. We have been working the plant for the two years ending in May of this year. In the first year we carbonized 734 tons of coal, and made 7 tons 8 cwt. 3 qrs. 7 lbs. of sulphate, or about 22½ lbs. of sulphate per ton of coal. This was sold at £11 10s. per ton, equal to £85 11s. 4d., less £3 for the licence and £17 14s. 11d. for vitriol and coke; leaving £64 16s. 5d., or slightly over 1s. 9d. per ton of coal. Last year we made a little more. Carbonizing 739 tons of coal, we made 8 tons 5 cwt. of sulphate, or 25 lbs. per ton of coal. This was sold at £11 per ton, equal to £90 15s., less the cost of the licence, vitriol, &c., £23; leaving a profit of £67 15s., or almost 1s. 10d. per ton of coal.

I am of opinion that distillation should be carried on with our liquid residuals so as to cover the primary products at the place where the residuals are produced; and the foregoing proves that it pays to make sulphate even in a small gas-works. I should say that works carbonizing from 300 tons of coal upwards (at least) should manufacture sulphate of ammonia.

Discussion.

The President, in inviting discussion, remarked that the subject dealt with by Mr. Frizelle was one of great importance to the members of the Association; and it had been treated in a practical and interesting manner.

Mr. Stormonth said he had had some experience in the manufacture of sulphate of ammonia; and he had listened with some considerable attention to the paper which had just been read. Much had been written and spoken on the subject of the manufacture and disposal of sulphate; and it was astonishing that the working up of ammoniacal liquor was not more general. From statistics he found that, out of a hundred gas-works in Ireland, eighteen only made sulphate. This was all the more remarkable because the greater number of gas-works in Ireland were small or medium sized, and in the majority of cases far removed from chemical works; so that the carriage which would be charged for conveying the liquor from one point to another would be in excess of the total sum realized on the finished product. The carriage between Coleraine and Belfast on the quantity of liquor required to make one ton of sulphate amounted to £4 10s. Consequently, it would hardly pay a sulphate manufacturer to take liquor such a distance. When sulphate fell in value some years ago, they reverted, in Coleraine, to the plan of disposing of the liquor to surrounding farmers; but they were not always in a hurry to remove it, and then he was compelled to run the surplus into a neighbouring river. This was not satisfactory; and, on thinking over the matter, he resolved to enter upon the manufacture of sulphate. A small plant was erected; and in October, 1887, operations were commenced. Since that time—that was to say, within three-and-a-half years—they had carbonized 4669 tons of coal, and had made 54 tons 11 cwt. 1 qr. of sulphate of ammonia, and the revenue they had realized from it was £589 6s. 1d. To make this quantity, they had purchased 53 tons of sulphuric acid, at a cost of £157 13s. 11d.; and the other items of outlay, including fuel, labour, &c., he estimated at the utmost limit to be about £80. Thus it would be seen that, by entering on the manufacture of sulphate, the Commissioners had realized a handsome profit. It also demonstrated that the manufacture of sulphate was more profitable than the plan of disposing of the liquor to farmers. He certainly did not agree with Mr. Frizelle that any kind of apparatus was good enough to make sulphate. Why should they adopt an ancient system when modern appliances were at hand? Modern engineers would never dream of erecting such an apparatus as Mr. Frizelle had described. Old boilers of the class mentioned were numerous, and could be bought cheaply enough; but this was because they were not monuments of economy—rather the reverse. He would not advise any member of the Association to have anything to do with them. If anyone wanted to enter upon the manufacture of sulphate, the advice to adopt was, get new plant simple in construction and easy to work. At Coleraine he had got on fairly well with the plant erected there. But, after all, sulphate making was an extremely simple process. After a time it readily adapted itself to the routine of the works, and it greatly enhanced the profits. His plant cost £150; but, of course, there was the building in addition. He was somewhat astonished that Mr. Frizelle should turn his waste gases into the main flue. That would not be tolerated at Coleraine, and, he understood, was not permitted since the passing of the Alkali Act. Mr. Frizelle had been at work for only two years, and he had obtained good results; but he (Mr. Stormonth) was satisfied that before many years had elapsed, he would be sorry he had not put down new plant. He knew of a town within a short distance of Belfast where plant of this description had been erected, and it had to be given up.

Mr. **Salmon** said he had been much interested by the paper, and was determined to give the manufacture of sulphate a trial in his own works. He would commence in the same way as Mr. Frizelle, and with similar apparatus; and when he had made some money, he would buy good plant.

Mr. **Williamson** thought it would be a good idea if the larger gas-works made an arrangement with the smaller ones around them by which the manufacture of sulphate could be carried on in the more important places. Mr. Stormonth, and others who were situated like him, could do so; and he was sure the arrangement would prove profitable to all parties.

The **Secretary** remarked that, in his opinion, papers such as that read by Mr. Frizelle were exactly what was required to make their proceedings profitable and instructive to the members. He must confess that he was much surprised at the figures Mr. Frizelle had placed before them. It was very creditable, he thought, that that gentleman should have been able to attain such satisfactory results, particularly when they kept in mind the modest character of the plant he had described. He had succeeded in doing much better than others who were a great deal more advantageously circumstanced, and who possessed the most complete plant to be had. He (Mr. Whimster) impressed upon gas managers the value and utility of manufacturing sulphate. He advocated it very strongly; and he thought they should even go farther than that. He not only boiled his ammoniacal liquor, but also his tar, and extracted the naphtha from it. After distillation, the tar was in a much better condition for sale, or for being burned in the furnace, than it was in its crude state. By these means they gained the naphtha, for which a good price could be obtained; and the result was to make the tar thus treated a far more valuable commodity.

Mr. **Stears** asked Mr. Frizelle if he used lime in the manufacture of sulphate.

Mr. **Frizelle** replied that he did.

Mr. **Stears** said the results obtained were most satisfactory, in fact, quite as good as if Mr. Frizelle had had at his command the most elaborate and expensive apparatus.

Mr. **Frizelle** said, before the discussion terminated, there was just one point upon which he desired to make a remark, and that was with reference to the escape of the sulphuretted hydrogen through the main flue. The Inspector called upon him on two occasions, and expressed himself perfectly satisfied with the arrangement.

Mr. **Salmon** supposed that there was a very high shaft.

Mr. **Frizelle**: Not exceptionally high—about 36 feet.

Votes of Thanks.

The usual votes of thanks were then accorded to the President and the other officials for their services during the year, as well as to Messrs. Williamson and Frizelle for their papers. The acknowledgments of the members to the Town Clerk of Belfast (Mr. S. Black), for his kindness in granting them the free use of the Town Hall for their meeting, were also expressed in a similar manner.

The members then proceeded to the gas-works, where they were most courteously received, in the absence of the Engineer and Manager (Mr. J. Stelfox), by Mr. Sharp, his assistant, and were shown over the establishment; the Claus purification plant, which has been erected there (but was temporarily out of action), being explained. At the close of the visit, the members dined together at the Castle Restaurant, Queen's Arcade. Mr. R. Ross occupied the chair; Mr. W. S. Stormonth being in the vice-chair.

MANCHESTER INSTITUTION.

QUARTERLY MEETING, AUG. 29.

This Meeting was held at Birkenhead. An exceedingly interesting programme had been arranged; and the attendance of members and friends on the occasion was one of the largest on record. Most of the party assembled at the Central Station, Manchester, and journeyed by the 10.30 a.m. train to Liverpool, where they were joined by others, and were cordially received by the President (Mr. T. O. Paterson, Assoc. M. Inst. C. E., Gas Engineer of the Birkenhead Corporation) and the Chairman of the Birkenhead Corporation Gas and Water Committee (Mr. H. Bloor). Waggonettes conveyed the whole of the party from the station to the landing-stage, whence they proceeded by the ferry to Birkenhead.

AN IRONCLAD IN CONSTRUCTION.

On arriving at Birkenhead, a visit was paid to the shipbuilding yard of Messrs. Laird Bros., where the ironclad the *Royal Oak* was being built for the Government. Mr. Henry Laird having given the visitors a cordial welcome, they were conducted over the new vessel by Mr. M'Culloch, Mr. Gibson, and Mr. Simpson, three of the chief employees.

Before leaving the works, Mr. J. CHEW (Blackpool) proposed a vote of thanks to Messrs. Laird Bros., for their kindness in permitting the visit. As Englishmen, they were, he remarked, all proud to know that there were private firms in the country capable of undertaking a contract so heavy as that involved in the construction of a ship of the size of the *Royal Oak*. It reflected the highest credit upon Messrs. Laird and their staff that they could do work like this, and do it quickly.

The vote of thanks having been carried by acclamation,

Mr. HENRY LAIRD briefly acknowledged it; and said the firm had been very glad to receive a visit from a representative body like the Manchester District Institution of Gas Engineers.

VISIT TO THE GAS-WORKS—COZE'S INCLINED RETORTS.

Conveyances were again waiting for the party as they left Messrs. Laird's place; and in a few minutes they were at the

Corporation Gas-Works. Here Mr. Bloor offered them a hearty welcome in the name of the Gas and Water Committee. The Committee and their Engineer (Mr. Paterson), he said, worked most harmoniously together; and they were proud of the fact that they produced excellent gas of 20-candle power, and sold it during the last year without any increase in the price—in fact, with a slight reduction.

Under the guidance of Mr. Paterson, Mr. Bloor, and the members of the Committee, a tour was then made of the works. In the meter and governor house, there was a new meter just put up by Messrs. Braddock, of Oldham, with a capacity of 100,000 cubic feet per hour. A conspicuous feature of the works was an elevated tower, into which the tar and liquor were pumped, and from which they flowed to the river level for shipment. But most interest attached to the experiment which was being made with the Coze system of inclined retorts. Mr. Paterson had at the time of the visit four settings on this principle, or 28 mouthpieces in all. The retorts were 11 ft. 6 in. long; and two or three were drawn and re-charged, in order that the members might see them in actual work. One very noticeable fact was that the men drawing the retorts were much cramped for room. Mr. Paterson explained that the settings were put up in accordance with the plans of the Company; but if any extensions were made of inclined retorts, far more space would be allowed for working them. They had experienced some difficulties which they did not expect to find, especially in charging the retorts. The shoot at the top, which passed the coal into the retorts, had a tendency to become clogged; and this had caused trouble with the men, and led to additional expense in working. He believed that this difficulty would be overcome; and if it were, the system would be very successful. They had no trouble in getting good heats. This, indeed, was obvious; for the retorts drawn were of a good heat, and the charges well burnt off. Mr. Paterson's settings had been exceedingly well built. The very finest material had been used in the combustion chambers; and the result of the three months' working was to show that in this respect a wise policy was adopted. In an adjoining retort-house, there were three beds of regenerator furnaces; and the house was being laid out with a view to the adoption of hand machinery when the whole of the beds were erected. Some of the settings there had been working for twelve months, and stood as straight as a line.

THE LUNCHEON.

From the gas-works, the party proceeded to the Town Hall, where they were invited to lunch with the Gas and Water Committee. After luncheon, a number of toasts were proposed and duly honoured.

Business Meeting.

The business meeting of the Institution was subsequently held in another room of the Town Hall.

The President expressed his thanks for the excellent attendance. He said although Birkenhead was a modern borough, it had an ancient foundation. A ferry had existed across the Mersey river for 1200 or 1300 years; and it had continued until it had come into the hands of the Corporation.

New Members.

Mr. W. T. Goodwin, Manager of the Congleton Gas-Works, was proposed as a member of the Institution by Mr. T. Newbigging (Manchester), and seconded by Mr. H. S. Norfolk (Leek); Mr. J. T. G. Cranshaw, of Tyldesley, was proposed by Mr. J. Timmins (Wigan), and seconded by Mr. A. T. Fletcher (Leigh); and Mr. W. Taylor, of Glossop, was nominated by Mr. T. Duxbury (Darwen), and seconded by Mr. S. S. Mellor (Northwich). These gentlemen were all elected.

Mr. T. Newbigging (Manchester) then read the following paper on

DIFFERENTIAL RATES.

When all the circumstances bearing on the question are considered, it appears such a reasonable and fair thing to make a difference in the charge for gas inside and outside of the limits of a town, that the view that there should be such a difference needs only to be stated to receive general acceptance. Singularly enough, however, the question as to whether or not there ought to be a difference in price provokes much difference of opinion. Every now and again we read or hear of an agitation being promoted in such-and-such a place for the abolition of the differential rate. Sometimes there is a shadow of justification for the claim of equal rates; but usually these agitations are not founded on reason.

Let us look into the subject. Take, for example, a town of considerable size. It covers an area which is thickly populated. There are streets in all directions, with dwelling-houses shoulder to shoulder; shops and warehouses of every kind abound; workshops and manufactories are numerous. Open spaces, alas! are fewer than is desirable. Evidently, in such a place there is a heavy consumption of gas within a comparatively small area.

This consumption is (say) at the rate of 5 million cubic feet per mile of main per annum. The gas-works belong to the town; and, besides supplying the inhabitants thereof, the main-pipes ramify out beyond the town limits into wide districts—it may be on one or two sides, or on every side of it. These outlying districts are largely residential. The houses, as a rule, stand apart; and there are often gardens to them, back and front. The population on an equal area is not one-half or one-quarter what it is in the town. There are not many shops, and but few warehouses; and there is an absence of manufactories. The consumption of gas per mile of main is light as compared with the other; amounting (say) to 2½ or 3 million cubic feet per annum. Here the unaccounted-for gas is necessarily higher; the capital expenditure is heavier in proportion to the consumption; and the expense of maintenance is more. It is clear, therefore, that the cost of distribution in the out-districts is greater, and the profit per 1000 cubic feet considerably less, than it is within the borough. This is not an imaginary case that I am putting, but one founded on actual circumstances within my knowledge.

Again, the ratepayers in a town owning its gas-works have to provide the capital for the hereditament as well as the working capital, and bear the risk contingent on the undertaking as a mercantile concern. Due cognizance must be taken of a fact of this kind. True, some of us believe that there is no real risk in the possession of a gas-works managed with care and diligence. That, however, is a point upon which, whatever may be our opinion, we have no right to dogmatize in connection with the subject of differential rates. If there is a risk (and a prudent administrator will assume that there is), the ratepayers have to encounter it; and, at all events, it is a legitimate argument to use. I go further than that, and say that if justice is to be done as between the inside and the outside consumer, the possible risk must not be left out of consideration.

According to the latest parliamentary returns, I find that there are in the United Kingdom 59 statutory companies and 35 local authorities charging differential rates; the amount of the difference varying from 2d. to 2s. 6d. per 1000 cubic feet. Of these, 20 have no maximum price fixed (14 of the number being companies under the sliding scale); 38 have only one maximum; and 36 a maximum within the town limits, and two or more for the outside districts.

It has been contended that where there is only one general authorized maximum, the charge for the gas should be uniform over the area of supply both inside and outside the town. How such an argument can be sustained I fail to see. It does not commend itself to my judgment as being at all conclusive; and if a case founded upon it should ever be stated for the consideration and decision of the Superior Courts, I have no doubt in my own mind that its falsity would be made manifest. The argument carries absurdity on the face of it. It is tantamount to saying that the owner of the undertaking should be compelled to supply gas at a loss.

In one or two recent instances, the right to charge a differential rate has been withheld by Parliament—notably in the case of the Oldham Corporation and the outlying townships, which are supplied with gas by the Corporation. But there were special circumstances here that helped to justify that decision. The Corporation have one gas manufacturing station situated in one of the out-townships, and they were seeking powers to establish an important station in another of the out-townships. It could scarcely be hoped that, under the circumstances, they could reasonably continue to charge a higher rate for the gas that was produced in the centre of the outside consumers' district, who had, moreover, to tolerate the existence of a gas-works at their very door. Clearly, this was a case where a "give-and-take" policy could be urged with some show of reason. But even in an extreme instance such as this, there is room for question whether, after all, the decision of our legislators was according to strict justice; and certainly it can never be put forward as a precedent to be followed in places where the conditions are altogether different.

The circumstance that it is the juxtaposition of a sparsely populated district to a large and thickly-populated town which enables the former to obtain its gas supply at a reasonable price, is often overlooked or wilfully ignored; and it would appear in some instances that nothing but the bitter experience of having to manufacture and sell their own gas at an enhanced price will teach ambitious out-districts the wisdom-lesson that some of them sorely need. I am no advocate for the harvesting, by local authorities, of exorbitant gas profits to go in reduction of the rates. So far from that, I have, in season and out, declaimed against the practice, which is as unfair as it is unsound and unwise. But it would be more grossly unfair to recognize the claim of the consumers of any out-district to have their legitimate gas charges reduced at the expense of the consumers within the limits of a densely-populated town.

If, in places where a differential rate prevails, it can be shown that the price exacted, as compared with the price within the borough limits, is in excess of what reasonably ought to be charged, then undoubtedly the outside consumers have a legitimate grievance. In such a case, a prudent gas committee would take steps to remove the ground of complaint, by adjusting the price to meet the circumstances. But, otherwise, they would be well advised in refusing to be influenced by unreasonable demands.

On the motion of Mr. I. Carr (Widnes), seconded by Mr. W. R. Chester (Nottingham), it was decided to postpone the discussion of the paper till the next meeting.

Votes of thanks were then accorded to the Gas and Water Committee, and to the Town Council in general, for the handsome manner in which they had entertained the Institution; to Mr. Newbigging, for his interesting paper; and to the President, for the manner in which he had occupied the chair an conducted the whole of the proceedings.

The meeting then ended.

Subsequently the members proceeded in one of the Corporation's steamers to Eastham, and, by permission of Mr. E. Leader Williams, C.E., the Engineer of the Manchester Ship Canal, walked round the docks at the entrance to the new water-way. Tea at the Eastham Ferry Hotel was followed by a journey back to Liverpool by the steamer. The programme was gone through without a hitch of any kind; and the members and friends present were once more indebted to the Honorary Secretary (Mr. Mellor) and the Committee for an admirably-arranged meeting.

SOUTH-WEST OF ENGLAND ASSOCIATION.

HALF-YEARLY MEETING, SEPT. 8.

This Meeting was held at Weymouth—Mr. S. W. Durkin, of Southampton (the President) in the chair. Before the business commenced, some of the members visited the gas-works. By the kindness of the Directors of the Company, luncheon was provided at the offices, where the meeting was subsequently held.

A Welcome to the Town.

The President, having taken the chair, introduced to the members the Chairman of the Gas Company (Mr. Alderman Thomas) and one of his co-Directors, Mr. Alderman Robbins.

Alderman Thomas said he wished to express the pleasure the Directors felt at the Association selecting Weymouth for their meeting that day. It was to their Manager (Mr. Lowe) that they owed entirely the success of the Company; and any compliment paid to him was always much appreciated by the Directors.

Alderman Robbins having also expressed the gratification it gave him in meeting the members,

The President said that, on behalf of the Association, he had to thank the Chairman and Alderman Robbins for the kind words they had uttered in welcoming the members.

Minutes of Last Meeting.

On the suggestion of the President, the minutes of the last meeting were taken as read.

A Vote of Condolence.

The President said that the next business was the passing of a vote of condolence to the family of their late friend, Mr. Henry Cockey; and the resolution he had to propose was as follows: "That this meeting desires to express a feeling of sincere regret on the decease of the late Mr. Henry Cockey, and to record the great esteem and respect entertained for that gentleman as one of the founders and Past-Presidents of this Association; also to convey a vote of sympathy and condolence to his surviving relatives."

Mr. T. HARDICK (Salisbury) seconded the motion; and it was passed by the members silently rising.

ANNUAL ACCOUNTS.

The SECRETARY and TREASURER (Mr. Norton H. Humphrys, of Salisbury) then presented his statement of accounts for the twelve months ending Aug. 31. They showed that, after meeting all expenses, there was a balance in hand of £18 10s. 2d.

On the motion of the PRESIDENT, seconded by Mr. T. W. R. WHITE (Sherborne), the accounts were adopted.

NEW MEMBERS.

The PRESIDENT then proposed, Mr. A. V. DANIEL (Portishead) seconded, and it was unanimously agreed, that the following gentlemen should be accepted as members of the Association: Mr. J. Robb, of Cinderford; Mr. P. Brace, of Monmouth; Mr. W. Stagg, of Bristol; Mr. F. Vince, of Trowbridge; and Mr. W. Lowe, of Weymouth.

ELECTION OF OFFICE-BEARERS.

Messrs. W. H. BRINKWORTH (Chippenham) and T. GILES (Bridport), who had earlier in the proceedings volunteered to act as Scrutineers of the voting-papers for the election of officers, presented their report. It showed that the following gentlemen had been chosen to fill the various positions:—

President.—Mr. D. Irving, of Bristol.

Vice-President.—Mr. E. C. Riley, of Swindon.

Hon. Secretary and Treasurer.—Mr. Norton H. Humphrys.

Auditor.—Mr. W. Higgs, of Basingstoke.

Members of Committee.—Mr. J. Nicholls, of Crewkerne; Mr. W. Parlby, of Hereford; and Mr. Frank Osmond, of Dorchester.

Mr. IRVING and Mr. RILEY briefly thanked the members.

A FEW REMARKS FROM THE PRESIDENT.

The PRESIDENT said he saw by the *agenda* that he had to make a few remarks. He would, in the first place, say he had been thinking of giving notice of a resolution to alter the rule as to the spring meeting, so that it might be held a little later. The latter part of March came just prior to the spring meter-taking; and so, if they altered it, they must fix a day which would be convenient after that work was over. He did not propose to give a second address on this occasion, as he considered that one was sufficient in a year's office. He might say, however, that in gas manufacture a sort of revolution was now going on. Whether the cumbrous methods in use would be continued, it was not for him to say; but there was evidence of other means being adopted to generate a large volume of gas in a much simpler manner than they were in the habit of doing at the present time.

PLACE OF NEXT MEETING.

It was decided, on the motion of the PRESIDENT, seconded by Mr. WHITE, that the next meeting should be held at Bristol.

Mr. D. IRVING then read the following paper:—

THE STOREAGE OF COAL IN GAS-WORKS.

The subject of storing coal in gas-works has for some time been engaging the attention of gas manufacturers, and is one of such importance to every member that I trust no apology is needed for bringing it before this Association.

It is doubtless the sincere aim of all gas engineers and managers to produce and deliver to the consumer good and cheap gas at the least possible cost; but it must be remembered that one of the first duties of the gas manufacturer is to provide a supply that shall be, above all things, reliable. In these days gas not only cooks our food, warms and illuminates our homes, but supplies the motive power and light for many large and various industries. It is, then, of the utmost importance to foster and develop our business in these new and desirable directions. We must be prepared to almost guarantee an absolutely regular and uninterrupted supply; and if this is to be done under all circumstances, it will be necessary to maintain a much larger stock of coal at the works than has hitherto been the case in many places.

There has never been a time in the history of gas manufacture, when a more constant, watchful, and wise attention was necessary on the part of those responsible for the successful conduct of the works. Especially is this true in regard to the proper storing of the raw material, and maintaining a reserve that shall place us in such a position that we shall be prepared for almost any emergency, at the colliery, in transit, or in our own works. It is generally urged against the proposal to provide adequate coal-storeage accommodation that the necessary sheds are expensive, the additional labour entailed costly, and the deterioration of the coal a serious matter. Whatever differences of opinion we may have upon these three several points, there is no question but that some stock of coal is necessary in every works. Our circumstances and surroundings are so various that no hard-and-fast rule could be laid down that could be applicable to every works; each manager or engineer must judge, and is best able to judge, of his own requirements, The general agreement, as to the necessity of ample storeage accommodation, of all the various members of the profession who have recently written or spoken on this subject, is striking. Mr. Newbigging some time ago stated that he had been in the habit of recommending, as a general rule, the laying in of a six weeks' stock of coal, reckoned on the basis of the mid-winter rate of consumption; and this rule seems to find very general favour. Six weeks' storeage, upon Mr. Newbigging's basis, equals about 20 per cent. of the coal received during the whole year, and would be equivalent to between three and four months' summer consumption. The question as to what is an ample and safe stock of coal will entirely depend upon the position and circumstances of the works in question. Works situated near or between two or more coal-fields, and drawing its supplies from each, and having more than one railway company upon which to depend for its supplies, would be able to work, and work safely, with a much less reserve than works situated some distance from the coal-fields, or works depending entirely upon sea-carried coal. Under the first-named circumstances, a reserve of about 10 per cent. of the annual amount carbonized might be considered a fair reserve store.

There is, it must be admitted, with many managers burdened with excessive capital, or having heavy working expenses which they are anxious to reduce, a great and natural reluctance to provide the necessary and desired covered accommodation, or yet even to store their coal in the open, because of the common experience that coal so stored rapidly deteriorates. They struggle on from hand to mouth, choosing rather to bear the worry and strain, in order that they may produce gas which shall be at once cheap to the consumer, and remunerative to their employers.

The respected President of the Southern District Association of Gas Managers, in his presidential address this year [*ante*, p. 4], in stating his experience of coal stored under cover and in the open, gives his preference, in the matter of disposition to heat, to that stored under cover. He remarked, however, that his coal-stores might possess some inducement for the coal to heat, from their relative position to the retort-house, where the temperature is much higher than in the open.

The causes of heating are due to the chemical changes of certain substances—such as iron pyrites, and other sulphur combinations, with the oxygen of the atmosphere in the presence of moisture. Professor Vivian B. Lewes, in a paper on the spontaneous ignition of coal in ships and stores, read before the Institution of Naval Architects,* gives the results of some comprehensive inquiries, and explains the cause of fires in coal cargoes, clearly demonstrating that the heating of the coal is due to its tendency to absorb oxygen in the presence of moisture. He shows that a coal in bulk, which contains much freshly-broken small, has a considerable power of taking up moisture, and is far more likely to heat and fire than a drier coal, even if the drier coal should contain a larger quantity of pyrites. The learned Professor proposes to distribute cylinders of compressed carbonic acid, secured by a fusible plug, throughout the bulk of the coal. The suggestion was not very favourably received, but was, to use the Professor's own words, "dropped upon." Experience has proved that, to store coal for any length of time, it is absolutely necessary that it should be as dry as possible when stacked. How is it possible to accomplish this in the open? It has been found that two or three wet days during the time that the coal was being stacked was sufficient to cause heating, and to endanger the whole stack of 6000 tons of Bristol district coal. No other part of the stack heated, except the particular portion exposed during the rain in question.

Another reason for storing coal under cover is that the water absorbed when in the open has to be paid for at the same rate as the coal for carbonizing. Exposed coal has been known to take up as much as 10 per cent. of water, in addition to its natural, or ordinary moisture. Coal containing (say) 5 per cent. additional water will, of course, increase the cost of carbonizing 5 per cent., which works out at 1·8d. per ton where the carbonizing costs 3s. per ton. The smaller the coal, the greater will be its power of retaining moisture. Bristol district coal, stored for three months in the open, has been found to depreciate over 10 per cent. The advantages gained by having and using dry coal, together with the increased work done in handling coal under cover, not to speak of the duty of protecting our workmen, will fully repay the cost of covered sheds. What is required in storing coal, either in the open or under cover, is that the coal should be fairly dry when stacked, and that it should be well ventilated. Wet coal will fire whether stacked in the open or under cover, if there be but sufficient bulk. It has been found that a coal with an exceptional tendency to heating will not fire, even if wet, if placed in a stack of not more than 6 feet deep. Coal in stores should be well ventilated with shafts placed every 10 feet, so as to prevent or check the first tendency towards heating. Inadequate ventilation is worse than no ventilation, because, if there is any tendency whatever to heating, it only serves to supply oxygen, and help the destruction of the coal. It is desirable to have an intelligent arrangement of coal-stores, so that a regular system of working the oldest coal first can be carried out. If coal is being stored which is likely to heat, a number of 1-inch pipes should be inserted throughout the stack, into which a thermometer could be lowered and the temperature taken daily. Whenever any indication of heating was found, the coal from that particular part should be used at once. Another system, to which attention was called by Professor Elgar, and recommended for consideration by the *Journal of Gas Lighting*, and which is understood to be compulsory in vessels carrying coal under the American flag, is that of having a number of steam-pipes—about 2 inches in diameter, and perforated with a number of ¼-inch holes—placed vertically throughout the coal. These pipes would also be available for taking the temperature as previously suggested. In case of heating, a flexible steam-pipe connection is attached at the end of the pipe nearest the heated coal, and steam blown into the suspected region. This system may be of some service if a considerable temperature has been attained in the coal, or if the steam could by any means be again conducted out of, or through the coal, then the large capacity of steam for heat might be utilized; but if the steam is to condense in the coal, would not the large amount of heat introduced be a source of danger? If it is a question of reducing or checking the action in the first stages of heating (and this is what should be aimed at), would not the danger to be apprehended from the large amount of latent heat introduced in the steam constitute an overwhelming argument against its use? It is well understood, of course, that there is no such thing as spontaneous combustion in connection with coal stored either in ships or stores. The heating in all cases extends over some time. The arrangement with iron pipes into which the thermometer is lowered enables the condition of the entire stock to be kept under daily observation. It will rarely be found, even with the most active coal, that the temperature will exceed a rise of over 3° C. in the 24 hours—that is, in the first stage.

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* See *Journal of Gas Lighting*, Vol. LV., p. 645; also Vol. LVIII., p. 574

It has been suggested, and in some few works carried out, that coal should be received at the gas-works in equal monthly deliveries. This course has been very eloquently advocated by Mr. C. E. Jones, the able and accomplished Engineer of the Chesterfield Gas and Water Works, who says : " I am convinced that it is to the best interests of the gas industry to prevent, or reduce to a minimum, colliery strikes ; and one undoubted means of so doing is the equalization of the output of coal." Take a works carbonizing 15,000 tons per annum. This works would require, under the equal monthly delivery arrangement, about 4170 tons of coal per month ; and from March to October 66 per cent. of the year's coal would be received but only 50 per cent. carbonized. During the remaining four months—from November to February—34 per cent. would be delivered ; but 50 per cent. of the whole year's coal would be carbonized. Under the general rule given by Mr. Newbigging, of providing accommodation of six weeks' maximum carbonization, there would be, at the end of February, in the works cited, a reserve in the stores of 4 per cent., or about 2000 tons, to which must be added any further margin of safety that local circumstances may require.

The cost of the stores as here set forth, including the apparatus for unloading and handling the coal, could be erected for about 40s. per ton, which, reckoned at 5 per cent. interest, and adding 2 per cent. for depreciation, gives an annual cost, which works out at 6·72d. per ton of coal carbonized. Mr. T. O. Paterson, of Birkenhead, states that he has taken deliveries during the summer months for September consumption, and that in one case he had obtained a reduction of 6d. per ton for coal so taken; but he thought the reduction was not sufficient to cover the loss entailed by storing coal for so long a period. If gas committees and companies could make any arrangements whereby the coal-owners could equalize the working of their pits and the time of their workmen, there ought to be no difficulty in obtaining a reduction of 6d. per ton on coal taken upon any such terms. It is not contended for one moment that there would be no deterioration with coal stacked in covered stores; but it is contended that coal mined and stored under the conditions named, would not deteriorate more than coal exposed for the shorter periods during the winter months. It has been aptly stated that " coal is better mined, better transported, and delivered in better condition in summer than in winter." Can it be maintained that coal delivered and housed in June will turn out worse at Christmas than coal that has been raised wet, and delivered into the retort-house in sloppy, wintry weather ? And since, all things being equal, it is easier to make gas in the summer than in the winter, would it not equalize matters if the coal which has been longest in store, were used in spring or summer, leaving the fresher dry-stored material for the winter's make? During the past two months, the rainfall in the Bristol district has equalled the extraordinary amount of 11·47 inches—equal to 4·77 cwt. per square yard, or 1155 tons per acre.

It is remarkable how little care and attention are given to the coal in some works. We are charged at times with being very unscientific in our methods. Picture to yourselves the condition of coal in works—and there are some—where every pound of coal used has been more or less exposed to the recent heavy rains, and where the small coal could scarcely be distinguished from road mud. Under such circumstances, surely little argument will be required to prove the advantage of well-arranged and ample coal-stores. After every provision has been made for suitably storing coal, and every preparation made for handling the same at a minimum cost, the greatest care and firmness will be required to prevent the coal contractor from using for his own convenience that which has been provided for yours. Alderman Miles has publicly stated that at Bolton they were well provided in the matter of coal-stores; and notwithstanding all the provisions they had made, they were reduced, in the winter, to something like 24 hours' supply; and this is not a solitary case. The contract specification should be clear and distinct; and, as far as possible, nothing should be allowed to interfere with the contract arrangement of deliveries.

In conclusion, the question is inevitably one to a considerable extent of profit and loss. Yet there are other important considerations to be kept in view—the security of supply to our consumers; the duty of providing protection for our workmen; and perhaps the collier, who is so often struggling for a larger share of the profits obtained from the coal he wins at the risk of his life, is entitled to our consideration.

Discussion.

Mr. T. Stone (Weymouth) said that some years ago they had a large amount of Somersetshire coal in store—he forgot how much there was; but he thought about 600 or 700 tons. As far as his knowledge went, the coal was put into store in a very good condition, to a depth of from 14 to 16 feet. It had not been long in store before he observed, by the odour, that there was something amiss. The shed in which the coal was stored was an inexpensive one, and was supported by wooden baulks. He discovered on the occasion referred to that the timber was burning; and he had the coal removed to a considerable depth

—he believed he got down about 10 feet—and there he found live fire. How far it extended, he could not judge; but he poured an immense quantity of water on the coal to extinguish, as he hoped, the flames prior to removing it entirely. However, the fire still made some headway; and finding it was yet alive the next day, he had the side of the store completely knocked out, and a large quantity of perfectly live fire was carted away. The whole was removed without any very great detriment to the Company; and as far as the balance-sheet went that half year, one could not discover that there had been anything amiss. He did not believe the coal was damp, as it had been stored in a dry condition.

Mr. IRVING asked whether Mr. Stone could say what amount of moisture was contained in the coal.

Mr. STONE replied that he could not.

Mr. NICHOLLS (Crewkerne) said he had had a little experience in connection with the question of spontaneous combustion. In his case, the coal was taken into store in the middle of summer. They had in store about 350 tons at a depth of 12 feet. The store adjoined the retort-house; being divided by a wall 2 feet thick, on the inside of which the coal was built up 1 foot away. Strange to say, the fire did not occur there; but in the opposite corner. He had at the bottom about 40 tons of one sort of coal, next 300 tons of another kind, and then on the top 20 tons of small coal. It was stored in this way so that they might make their own "through and through." Before the end of July of that year, they had in store almost a whole twelve months' supply; and the coal was not touched until the last week in December or the first week in January. They did not discover any smell coming from the coal until about 24 hours before they saw the flames on the top of the heap. He worked all round the wall, and found fire the whole distance. The men took out coal seemingly as good as it was the first day it was delivered; and when it was put into a barrow, it was found to be a whole mass of fire. They wheeled the coal out and tipped it into the snow, and then used the larger portion of it in that condition. Some of it they were obliged to throw away; but fortunately the coal was insured.

Mr. T. HARDICK said that he had not had much experience in the firing of coal. When he first began gas making, they used all small coal, from which they realized only about 5000 cubic feet of gas per ton. Afterwards his supplies turned out more advantageous; and they then obtained more than double the quantity out of it. After this he found a little firing occurred; but this was not under cover. For many years since then, he had used up all the small coal in the summer with an extra retort, piling up the lumps in the open; and the result had been that he had never experienced any difficulty. He did not remember what was the yield from the large lumps stored outside; but he recollected that he suffered by having a great deal of soft coal mixed with it. If managers of small works would adopt the plan of using the small coal in the summer, and stocking the large lumps in the open, they would never be troubled with firing.

Mr. Stone said he wished to mention that he had the wooden supports of the roof of the coal-store he had alluded to taken out; and they erected brick shafts to ventilate the place. These acted admirably for the coal then used; but they soon resorted to north country coal altogether, and he never experienced such trouble again.

Mr. J. Lowe (Weymouth) observed that his experience of coal heating was very limited; and the remarks he had to make would bear upon the paper read by Mr. M'Gilchrist at the last meeting of The Gas Institute at Carlisle.* That gentleman suggested that, in order to extract the moisture from the coal, flues should be constructed from the retort-bench, under the coal-stores, to the chimney-stack. Now he (Mr. Lowe) had found that the heat coming through a 21-inch wall had been the cause of the only instance he had had of coal being set on fire. The coal he then generally used came from the Radstock district; and it was placed against a wall, on the other side of which was a boiler-shaft. He had stacked coal against the wall for months; and they never before had the slightest inconvenience. In this case he was driven to use Somersetshire coal; and the heat produced by the boiler-flue on the opposite side of the wall induced it to catch on fire. He advised managers who used Somersetshire coal to avoid anything like heat in the proximity of the store.

Mr. N. H. Humphrys (Salisbury) said that spontaneous combustion appeared to be rather a mysterious thing. They found it happening in several other substances besides coal—such as oil waste, hay-ricks, and things of that sort—in fact, in any organic matter. With regard to coal, they had been accustomed to assume that it had been due to the pyrites or sulphur in the coal. The Somersetshire coal was almost free from sulphur in any form—more so perhaps than any other coal. He did not suppose there was more than 1 per cent., or 1·2 per cent. of sulphur in it in the way of pyrites or anything else; so that he did not think the sulphur theory accounted for the spontaneous combustion of that class of coal. Then, again, on the point of moisture, they had heard Mr. Stone say that he stored his coal quite dry. He (Mr. Humphrys) was of opinion that spontaneous combustion began in the case of coal that was in a finely powdered condition. Among other things, he had been in the habit of dabbling in chemistry a good deal; and he sometimes made powders which caught fire when exposed to the air. To make one of these powders, they had simply to get a metal finely powdered; and then take any organic salt—such as oxalate—that would burn on the application of heat. On putting these into a tube, and heating it, the salt would burn, and leave the metal behind in a state of very fine division. It was really the same with regard to coal. Some portions of it got crushed into a fine powder; and it was when in this condition that combustion commenced. Thus the really practical point they had to think of was how to keep the dust out of the way in the coal that was stacked. At the same time, fortunately, spontaneous combustion did not happen very often; but it was more or less likely to occur. If, therefore, one had a large heap of coal, and could insure it, it was a very wise thing to do.

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* See *Journal of Gas Lighting*, Vol. LVII., p. 1300.

Mr. W. Davis (Poole) said that Mr. Hardick had rather encouraged him to speak; because he was under the impression that the remarks he should make would be so much against theory that the members would scarcely believe his statement to be correct. His experience had been with South Wales coal —the Glynos coal. At one time they had their coal through a contractor, and then it was delivered into the store as required. But when the Corporation acquired the works in 1872, they purchased their own railway-waggons, and then bought the coal at the pit. These waggons had to do their work both in summer and winter. They were not equal to conveying the quantity required during the winter, but they could bring in considerably more than was needed during the summer. Their coal-store would only contain about 200 tons; and this was a very trifling amount, with eight 10-ton waggons running generally twice a week. The consequence was that a large quantity had to be stored out in the open, and exposed to all weathers. It was piled up about 8 feet high against a wall, and covered a very large area. As fresh coal came in, it was packed up on the face of the heap, and it was worked away from the face; so that the coal that was stacked first remained there for at least three years, until the new gas-works were built. Although the coal had been stacked in this manner all that time, he failed to find any appreciable difference in the quantity or quality of the gas produced from it—the yield being (using from 3 to 3½ per cent. of Curley cannel from North Wales, or some other cannel) 11,186 cubic feet of 14-candle gas per ton.

Mr. E. C. Riley (Swindon) remarked that the one point which seemed to be dealt with by the members was that of spontaneous combustion. He was happy to say that he had had no experience in that direction. It appeared to him the practical question for them as gas managers was the one mentioned by Mr. Irving in the latter part of his paper—viz., that of pounds, shillings, and pence, or whether it was worth while or necessary to provide covered coal-stores for a sufficient quantity of coal to meet any variation in the delivery, or as an adequate reserve for the requirements of winter. Mr. Irving had named 6d. per ton on the amount of coal carbonized as covering the cost of proper coal-stores; but he (Mr. Riley) thought they should add to that 6d. per ton for putting the coal into the store and taking it out again. This brought them to the question as to whether the expenditure necessitated in the provision of coal-stores was repaid by the additional value of the coal as stored in covered and properly-constructed buildings as against coal stacked in the open. In connection with this question, of course the quality and character of the coal was important. A great deal of allusion had been made to Somersetshire coal. During the past winter, a considerable quantity of this coal was provided at one of the Great Western Railway Gas-Works to meet emergencies. This stood simply as a reserve in case of any difficulty in the supply; and when they were well into the spring, they determined to use the whole of the stock, so that fresh coal could be obtained during the summer for next winter. Before using the coal, his assistant (Mr. J. Faulkner) specially tested some of it; and the result showed a loss in value of nearly 10 per cent. But when they came to use the bulk of the coal, they found that the loss had only been a little more than 3 per cent. This difference no doubt resulted from the coal which had been tested having been taken from the outside of the heap. The question, therefore, came to this (especially if there was any difficulty in getting the necessary capital), Was it not as profitable to store the coal in the open, taking care to avoid putting in too much small, as being committed to the expense of a coal-store? He should like to ask, in conclusion, whether Mr. Irving was in a position to give any information as to the machine Mr. Trewby had recently called attention to, for putting coal into store and taking it out again when required.*

The PRESIDENT said that some years ago he had a little experience of coal firing; and he found that the odour which arose during this so-called spontaneous combustion was one which would never be forgotten. In this instance, the coal was stored to the depth of about 14 feet. A portion of the coal-store ran to the end of the retort-house; and the heat from the benches was conveyed from the retort-house wall to the end of the coal-store; and just in that corner the ignition partially took place. The coal was removed; and a hollow wall was built with air-ducts right through it, so as to have a stream of cool air passing. Not very long since he found a similar thing taking place; but in this case, the coal was a "stray" cargo (which they were glad to take during the severe weather); and there was a good deal of charcoal in it. Close behind where this coal was stored was a stove by which the men cooked their food; and the heat conducted through the wall was the means of partly heating the coal. He was not able, without going to a great deal of expense, to use his coal-store in the summer months, as it was a good distance from where they wanted to use the coal; and therefore he did not feel warranted in spending money in wheeling it. Where coal was stacked, and not used, they always made it a point to drive down ¾ or 1 inch pipes, and to withdraw them once a week to ascertain whether there was any increase in the temperature. With regard to having coal in the open, he had an instance where 500 tons were stacked outside; and the supplies coming in more regularly than was anticipated, this heap was not worked off till the summer. He was surprised to find how little moisture had penetrated into it; for about 8 or 9 inches down it was damp, but inside it was perfectly dry.

Mr. IRVING, in replying upon the discussion, said he thought it must be admitted that the storeage of Bristol district coal required very great care, whether in the open or under cover; but the question of using local coal, or coal from another district, was entirely one of profit and loss—it must be decided by every manager for himself. Mr. Humphrys had dealt with the cause of the heating of coal; and as to his remarks about the sulphur contained in Bristol district coal, he generally agreed, except that the total sulphur ran a little higher than he mentioned. He (Mr. Irving) did not think that the heating was due entirely to the sulphur; and he believed it took place in the small coal in the presence of moisture, and that the sulphur compounds were the first to ignite and fire the coal. What he suggested in the paper was not so much how to prevent the heating, as how to detect it. He could scarcely understand coal bursting into flame, without there being something to attract attention previously. His experience concurred with that of the President—that heating took place in coal even when in the open, and that anyone moving about could not fail to detect it. With regard to the additional handling of the coal, there were very few works where the whole amount required could be put down just where it was wanted for carbonizing. It must be lifted once; and if the coal-store was convenient and well arranged, this could be done without any extra cost. With reference to the coal machine referred to by Mr. Riley, he was afraid it could not be used except in very large works. What he contended in the paper was shortly this: That coal stored under cover would in the end be cheaper, and produce better results than if it was left exposed in the open.

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* See Inaugural Address to the Incorporated Institution of Gas Engineers, *Journal of Gas Lighting*, Vol. LVII., p. 884.

VOTES OF THANKS.

On the motion of the PRESIDENT, seconded by Mr. HARDICK, a vote of thanks was passed to Mr. Irving for his paper.

A similar vote was accorded to the Directors of the Weymouth Gas Company for the kind reception they had given the Association.

Mr. WHITE then moved a resolution thanking the President for the able manner in which he had conducted the affairs of the Association; and it was unanimously agreed to.

The PRESIDENT heartily thanked the members for their cordial vote; and concluded by proposing that a similar compliment be paid to the Hon. Secretary and Treasurer, and also that an honorarium of ten guineas be voted to him for the additional work which had fallen upon him.

Mr. IRVING seconded the proposition; and it was carried.

Mr. HUMPHRYS briefly acknowledged this kind recognition of his services; and the business proceedings then terminated.

The members and friends subsequently dined at the Victoria Hotel; and later in the afternoon, they had a sea-trip by a specially-engaged steamboat. Altogether, the day was a most successful and enjoyable one—attributable in great measure to the assistance given by Mr. Lowe in making the arrangements.

EASTERN COUNTIES ASSOCIATION

HALF-YEARLY MEETING, SEPT. 16.

This Meeting was held in the Council Chamber, Cambridge—Mr. J. CARTER, the Manager of the Lincoln Corporation Gas-Works (the President), in the chair.

AN OFFICIAL WELCOME.

The PRESIDENT having introduced to the meeting the Mayor (Mr. F. C. Wace, M.A.) and the Chairman of the Gas Company (Mr. Alderman C. Balls, J.P.),

The MAYOR said he did not wish to intrude upon the business before the meeting; but he merely desired, in a few words, to give the Association a hearty welcome on behalf of the inhabitants of Cambridge. It was with very great pleasure indeed that he was able to comply with the request that was made to him for the use of the Council Chamber for the meeting. He was glad to see so large a gathering of members; and he hoped the meeting would prove a very successful one.

Alderman BALLS observed that it would ill become him to take up the time of the members in addressing them, seeing that they had a good deal of work before them of a most interesting character. He was pleased to have the opportunity of being present to listen to the papers and discussions; and he should regard it as quite an event in his life—having been connected with the Cambridge Gas Company for a great many years—in having assisted in welcoming to the town gentlemen who were so deeply interested in the gas industry as were the members of the Association.

The PRESIDENT said it was his pleasure to give voice to what he was quite certain was the general feeling of all the members—viz., their sense of obligation to the Mayor and Alderman Balls for being with them that morning. They were all sufficiently acquainted with municipal life to know how varied and pressing were the demands made upon gentlemen who were charged with the administration of local affairs; and for the Mayor and Alderman Balls to have found time to come to the meeting to welcome the Association, was a matter of great gratification to each one present. On behalf of the members, he asked them to accept their best thanks for the kind words of welcome to which they had given expression.

MINUTES OF LAST MEETING.

The HON. SECRETARY and TREASURER (Mr. H. Wimhurst, of Sleaford) read the minutes of the previous meeting; and they were confirmed.

ELECTION OF NEW MEMBERS.

The following gentlemen were elected members of the Association: Mr. T. H. Martin, of Barnet; Mr. E. G. Smithard, of Chelmsford; Mr. H. Plowright, of Swaffham; Mr. J. G. Hawkins, of Spalding; and Mr. G. Cutmore, of Nayland.

Mr. F. WELLER (Southtown, Yarmouth) then read the following paper, entitled

THE ECONOMICAL WORKING OF A SMALL GAS-WORKS.

Considering there are in England no less than ten different Associations of Gas Managers, where from forty to fifty papers a year are read, it is somewhat curious that there are only about three of the whole of that number which are on the subject of small gas-works. I trust, therefore, I may be excused for introducing it, and for expressing the hope that it will meet with a good discussion.

Assuming that the works have been built in the most convenient situation—viz., handy for carting coals, &c., by water, road, or rail, and also at the lowest possible level obtainable, with plenty of room for extensions—the first thing to be considered is storeage. At my works I have two holders 62 feet in diameter by 22 feet deep, each capable of containing about 62,000 cubic feet of gas. This, no doubt, would be thought by some to be rather large, considering that my annual make is only 14 millions. I find it, however, a source of great economy; and I am sure it doubly pays for the capital expended. Having this quantity of storeage space, I can, by filling the holders full when the consumption begins to increase, run a fortnight or three weeks before I have to put on another bed of retorts. This means a great saving in labour and fuel. It is, of course, the same when the demand is decreasing. For instance, on the 1st of March this year I filled the holders up to 101,000 cubic feet; and let out a bed of six retorts. In working through the month, we sometimes lost as much as 6000 cubic feet in 24 hours, and were sending out, on an average for the month, 2000 cubic feet per diem more than we were making. So that at the end we had only 39,000 cubic feet of gas in stock, when we began to hold our own. By this we saved upwards of 30 chaldrons of coke and one man's labour. Before passing from the subject of storeage, I may say that both our holders are fitted with circulating boilers, which I have found very convenient, especially last winter; for in the most severe weather, the water in the tank opposite the boiler was milk warm. I should strongly advise all who are not supplied with circulating boilers to have them before next winter. They cause little trouble; and the expense for fuel is slight.

I think the next important point to be considered is the most economical kind of retort-setting for small gas-works. Though we are not in a position to undertake experiments with regenerators or inclined retorts, I think in all smaller works a supply of secondary air might be tried. The plan on which my settings are worked [shown on a drawing exhibited] is very simple and inexpensive, as no special lumps or bricks are required, and they give much higher heats while consuming less fuel. I also prefer oval to any other kind of retorts, as they wear better than the ⌓ shape, and afford more heating surface than circular ones. I have four beds in my retort-house—two of five, and two of six retorts. The retorts in the former are 21 in. by 15 in., and 9 feet long. The four bottom retorts in the beds of six are the same size; but the two top ones in each bed are 14⅞ in. by 15 in., and 9 feet long. I had to make these smaller, to allow room for the side middle ascension-pipes. When building this stack, I had to put a bed of circular retorts in the coal-store adjoining the retort-house; and I have found it very convenient in the summer, when there is not enough work for the exhauster. At the same time it allows us to thoroughly clean, repair, and renew, ready for the coming season. The mouthpieces are all fitted with Morton's patent lids of the latest type.

A word about ascension-pipes. I think it a great mistake to have anything less than 6-inch pipes. I have none smaller, and should not like to have any. We are never troubled with stoppages—a happy condition which, no doubt, may be attributed to our having the pipes large enough, and a good 14-inch front wall. Hydraulic mains, I prefer in sections—one to a bed—fitted with a dip-regulating valve to each section, so that the dip can easily be regulated to each bed of retorts. My condensers are vertical—three stacks of 5-inch pipes, seven pipes in a stack, with a circular box top and bottom. But if I were making alterations, I should certainly have one of Morris and Cutler's, as I think they are much more effective.

There is a great deal of controversy as to the best kind of engine to be used in small gas-works. Some are in favour of gas, and others of steam engines. I must say I very much prefer the latter, as most of my pipes lie very "fleet;" and in frosty weather I am obliged to have a jet of steam continually running through them. I have also steam in the suction and delivery tar-pumps, as I pump the tar from the well, and deliver it into tanks about 30 yards from the pumps. I have also steam connections to the condensers, the scrubber and the inlet and outlet of the exhauster, the bye-pass of which would be a source of great trouble, as the pipe is only a 2-inch out of an 8-inch. This, I think, is a mistake. The bye-pass should be the same size as other connections—viz., 8 inches. It would be much more safe than with so small a throttle-valve. The exhauster is one of Beale's; and I have no trouble with it so long as the governor and bye-pass are kept clear.

I think a scrubber fitted with boards is more economical than one charged with coke or boulders; and it is very simple. The way in which I charged my scrubber with boards was this: I took a template of the inside, with the outlet-pipe in the centre, and had a number of ½-inch boards cut. I then cut the boards in lengths, put ½-inch pieces between them, put one layer one way and the next layer crosswise, and so on right up—forming ½-inch squares all over. These went on for a period of seven years without needing cleaning; whereas when the scrubber was charged with coke, it had to be cleaned out and renewed every two years. The same boards, after being cleaned, went in again, with the exception of a few broken ones. A word about the four-way valve at the bottom. Of course, there are four divisions, and each division is provided with drain-pipes to the seal-cup. Now, the great mistake with these drain-pipes is that they are much too small. I think they might carry the chambers the same size to form the seals, which would save a great deal of trouble, as most of the stoppages take place in this valve. I have a steam-tap at the bottom of the scrubber, and one about halfway up; so that I can clean out the scrubber in case of any tar getting in.

I have only three purifiers, 8 feet square; but I think of soon putting down another of the same size, for I do not consider a set of purifiers complete unless there are four. In my opinion, lime is better than oxide for small works, especially with only three purifiers. I use lime—three layers about 6 inches thick, and a top layer 9 inches thick. I tried to do away with two sets of grids, and laid the lime in double thickness; but I found this would not answer, as the lime in the centre of the layers was scarcely soiled, and did not purify much more than half the quantity of gas compared with the four tiers.

I consider that no works should be without a photometer and sulphur-testing apparatus; the Harcourt colour test being especially suited for small works, both for cheapness and simplicity. Governors, of course, must be arranged according to the levels of the district to be supplied, and the pressure kept as low as possible to prevent leakage.

Too much care cannot be given to mains and services. The former should be started large enough from the works, and continue the same size to the end of the district, instead of being reduced, as is often done. Of course, junctions to bye-roads may be smaller; but nothing less than 3-inch cast-iron pipe should be laid, unless for a special service, as the 2-inch pipe is liable to break where it is tapped. Indeed, I have found it broken in several places when I have been taking it up to lay larger; and I therefore make it a strict rule not to put in 2-inch pipes for mains. With respect to services, I think a manager ought to superintend every one that is laid, and not allow any man calling himself a gas-fitter to lay them. I do not permit anyone to touch anything on our side of the meter, and not even to fix the meter. I have all this done by my own men. I contract from the main to the burners, if consumers wish it, and let them select their own fittings from illustrated catalogues, as I consider this is more satisfactory to them.

The public lamps ought not to be passed by without a few words. In the first place, those of you who have not already done so should take out all the ⅜-inch bends at the bottoms of the columns, and all the ⅜-inch pipes underground. I suppose there are not many here who did not have a great deal of trouble with them last winter. I know we had, at Yarmouth; but we never allowed one to be out all night unless the pipe burst. There are several ways of clearing a frozen lamp. Some use spirits; but this takes half a night to clear half-a-dozen. We use a ¼-inch rod, sharpened at the point, and run it down into the bend; we then have what we call our "gun," which is a common plug with a gun-nipple tapped into the centre, put a little powder in the socket, screw it on to the top of the stand-pipe, put a percussion cap on the nipple, and give it a tap with the pliers. This is almost sure to clear it. It is not economy to work with too short a staff of lamplighters, as a great deal of unaccounted-for gas occurs with the public lamps when the lamplighter cannot get round in the time allowed him. One word about lamp-governors. I have tried a great many, but have not found any to equal those I am now using—viz., Hawkins and Barton's patent; and the same may be said of their burners, which I strongly recommend to all my consumers, and find they give great satisfaction.

I think every manager ought to do all he can to encourage the day consumption of gas for cooking, heating, and motive power. We have reduced the price 6d. per 1000 cubic feet for cooking purposes; and we fit up stoves and supply and fix meters free of charge.

With regard to general extensions, I think it is unnecessary expense, in a great many cases, to employ a consulting engineer; and I consider every manager ought to be able to design and superintend all alterations and improvements without any other help than that of a local architect and good tradesmen.

Discussion.

Mr. W. Duesbury (Cambridge) observed that Mr. Weller's remarks with regard to the storeage of gas were very true. Plenty of storeage meant economy; and to be short of storeage meant—he would not say extravagance, but certainly waste. If they had to fire up beds of retorts just as the consumption varied, it was a very expensive proceeding. As to the question of main-laying, he would reiterate the author's statement that 3-inch pipes were quite small enough; and if every manager would come to the decision never to lay pipes of less diameter, he would find it would be to his advantage.

Mr. W. Barratt (Grantham) remarked that there were some points in the paper with which he did not think the members would all agree. With regard to the question of having photometers in small works, he did not consider it necessary to emphasize this, as the author seemed to think. If they had photometers, it was necessary to have someone who could use them; and a great many men in small works were not capable of doing this. As to the size of gas-mains, if pipes of small diameter were put down, they would cause trouble in many ways; and most of the members would endorse what the author had said as to service-pipes. He did not, however, exactly see the force of the "clearing-out business" explained by Mr. Weller; but, on the whole, the paper was calculated to do good.

Mr. B. Gibson (Haverhill) inquired whether the author considered that purification with oxide and lime was better than with lime alone.

Mr. W. J. Best (St. Ives) observed that the paper covered such a wide range of subjects, that it was impossible to deal with them all. With reference, however, to the construction of the retort-furnaces, the question of a secondary air supply was perhaps a little fad of his own. If they had three fire-bars in the furnace, it would be found that the flame would go up the chimney; but if they took out one bar and had two, using a secondary air supply, the heat would all be retained in the furnace. The author advocated the use of large, instead of small, ascension-pipes, to avoid trouble; but he (Mr. Best) thought that, if the ascensions were kept a reasonable distance from the setting, they would not cause much difficulty. He disagreed with the writer as to the way he used lime in the purifiers. In his own case, he now only employed one set of grids, and found he was able to do more work. As to the lime in the middle of Mr. Weller's purifiers not being soiled, this was owing to bad working; the gas no doubt simply passed up the sides of the boxes, instead of through the lime. In connection with the laying of cast-iron pipes, he might mention that he only used galvanized pipes for services; and he had noticed in cold weather that iron pipes seemed to assist the formation of naphthalene more than galvanized ones.

The President remarked that the President of The Gas Institute (Mr. W. A. Valon, of Ramsgate) had honoured them with his presence that day; and they would be pleased if he would take part in the discussions.

Mr. Valon said he had not prepared himself to say anything upon the paper, as he could not possibly know what it was going to contain; but he must say that the author had gone through his works from one end to the other in a way which showed that he himself was quite capable of managing a small gas-works. There were, however, two or three points upon which there might be a little difference of opinion. The first was that gas-works should always be at the lowest level obtainable. He did not quite agree with this—that was to say, it was not at all necessary to have the works at the lowest possible point, unless circumstances demanded it. Supposing they were depending upon their coal supply by rail, or had to cart the coal from the part where it was landed, then it was not at all essential that the works should be situated at a low point; indeed, he (Mr. Valon) thought it an advantage to have them on high ground. If the coal was brought by water, then it was necessary that the works should be at a low point; and this was the only excuse for having them so situated. If they were situated at a high altitude, then the smell which naturally arose from them passed over the town. The gas could be easily led to the lowest part of the district by a trunk main from whatever height the works might be—the governor being fixed at the works the same as if they were at a low point. Of course, the additional pressure would necessarily be something more than if they were on low ground. If they were at an altitude of 100 feet above the lowest part of the district, they would require a pressure of 10-10ths to drive gas to that part. But supposing they had the initial pressure at the lowest point, and the gas had to rise 100 feet, at that height they would have an increase of 10-10ths in the pressure. It would be seen by these remarks that his idea was that, excepting where they had water carriage, and other things being equal, the gas-works should be rather at a high point than at a low one. Then, with regard to the storeage of gas, Mr. Weller had certainly erred on the right side in having two holders with his make of 14 million cubic feet. He agreed with him that large gasholders were economical; and it was always advisable to have a considerable margin of storeage on the works. With reference to the subject of purification, a question was asked as to whether oxide of iron was more economical than lime; but before this could be determined, it was necessary to know the conditions under which the materials were to be used. As to the use of lime in the purifiers, he did not think there should be any difficulty in passing gas through 18 to 24 inches of lime, if it was properly slaked and turned and put into the boxes. He thought that Mr. Weller would find there was some fault in the way the lime was used, if he had any trouble in passing his gas through such a thin layer as he would call 8 to 12 inches. Towards the close of the paper, he saw Mr. Weller was very anxious that gas managers should do all they could to increase the quantity of gas burned in their districts. He (Mr. Valon) thought this was the great object of them all—they wished to see the works in their charge making as much gas as the district could possibly consume. He might mention the great success that had followed the reduction of the periods in which gas accounts were rendered in the case of three or four works under his guidance, and especially at Ramsgate, where they had established weekly payments for gas—taking the payment in advance for (say) 500 cubic feet, and supplying the fittings free of cost. They charged a little more than the price to the ordinary consumer. The cost to the latter was at present 3s. 2d. per 1000 cubic feet; and prepayment consumers were charged 3s. 9d., or 4½d. per 100 cubic feet. This was about

½d. per 100 feet more than the general consumers paid; and was for interest on the outlay for the fittings and the meter. By this means, they found that during the last two years they had "tapped" a class of consumers they could never have secured in any other way. In the two years they had added upwards of 500 consumers, who would never have used gas if this scheme had not been introduced, for the simple reason that there were many persons who were not able to pay the first £4 or £5 outlay (which would be the average amount a gas-fitter would charge) for fitting up a house. If the gas manager could relieve the occupants of small houses of this expense, and give them their fittings free of cost, simply asking them to pay weekly or fortnightly, it would be found that they would have no difficulty in tapping a source of revenue which had never been opened up before. He was so thoroughly impressed with this, that he really believed, when it came to be worked out, they would find that the present system of three months' credit was a mistake; and the shorter rendering of accounts and the more frequent payment of them would lead to an increase of consumption and a reduction of bad debts.

The **President** remarked that he thought the members were under considerable obligation to Mr. Weller for bringing forward a paper on the subject of the working of small gas-works. They had a district which included a large number of these works; and to draw their attention to the principles that should guide them in conducting such concerns, was extremely useful.

Mr. **Weller**, in reply, said as to Mr. Barratt's observation that in many small works they had no one to use a photometer and to make proper tests for sulphur, he thought they ought to bring up their young assistants to do work of this description. With respect to the question of purification, he specially mentioned in the paper that his purifiers were only 8 feet square. His idea was that, with oxide, they should have a catch purifier; and therefore they ought to have four boxes. As to the depth of the lime in the purifiers, he tried the experiment of taking out two sets of the grids, and putting in a double thickness of lime. With lime the average amount of gas dealt with in his ordinary working was about 3 million cubic feet for each purifier. But when he took out the two sets of grids, he could not deal with much more than half the quantity; and when the lime was removed, it was quite white in the centre. With reference to Mr. Valon's remarks, he (Mr. Weller) thought it was an understood thing that gas-works should always be at the lowest possible point. Where works were situated at a low level, one governor was generally found sufficient; but where works were located at a high point, three or four governors had to be used. If, however, they employed a trunk main, as suggested by Mr. Valon, they could then possibly do away with two. With regard to Mr. Best's pet scheme of secondary air supply, he confessed that, when it was brought forward at the Ipswich meeting, he did not understand it. Before concluding, he strongly urged gas managers to have their holders fitted with circulating boilers.

The President said that the next item on the *agenda* was a paper by Mr. F. J. Ward, of Amersham, on the question of the rating of gas-works. They had received a telegram from that gentleman saying he regretted that unforeseen circumstances prevented him being present at the meeting; and therefore he (the President) would ask the Secretary to read the paper.

The Secretary read the paper, which was as follows:—

GAS-WORKS RATING.

The question of the assessment of gas-works is, to my mind, a very important one; and I may therefore be pardoned for venturing to call attention to it, although I may say at once that, personally, I have no special knowledge of the subject, and that it is only to learn the opinions of others, and to give the members an opportunity of expressing their views on the matter, which I feel sure is of considerable moment to us, that I offer a few remarks upon it.

In looking round, I find that the assessment question is one which has to some extent been neglected, although Mr. W. Carr, then of Halifax, read at the meeting of The Gas Institute in Manchester in 1885, a very able and comprehensive paper upon it, in which he gave a valuable table showing the inequalities and total unfairness in a great many cases, of the present system of rating. Then, again, Mr. Norton H. Humphrys, in 1885, wrote a series of articles in the *Gas Engineer*, indicating the mode by which the rateable value of gas-works and plant is arrived at, and giving several cases showing its operation. Coming down to last year, we had published in the *Journal of Gas Lighting* a series of articles from the pen of Mr. Thomas Newbigging, C.E., and since published in book form,* all tending to shed light on the question. But to my mind the matter is still in almost complete chaos; consequently, there is room for a great deal to be done before the assessment of gas-works will be as easy to every intelligent person as reading a meter or making out a gas account, although I am positive, if it is looked at from all points fairly and squarely, there should be no more difficulty in it than in assessing an ordinary dwelling-house.

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* "The Valuation of Gas-Works for Assessment," with an Appendix of Decided Cases. By Thos. Newbigging, C.E. London: Walter King.

Now let us look for a few moments at the present mode of assessing gas-works—that which is generally adopted by professional valuers, and also by most gas engineers—a mode which, if we read the cases that are reported from time to time in the publications as the effect of its application, is anything but satisfactory, and is capable of being so pulled and twisted about by valuers and counsel as to make a very considerable difference in the results arrived at by opposite parties. Take for instance the case of the Peterborough Gas Company, of which one of our respected Past-Presidents, Mr. Barton, is the Engineer and Secretary. There we find a great difference between the amount arrived at by the valuers for the Assessment Committee and those for the Gas Company. The latter put the rateable value of the works and mains in the parish of Peterborough at about £2350; whereas the former valued them at about £3600.* Thus we see what a wide difference there can be in the amount arrived at by two sets of valuers.

The mode by which the valuation of gas-works is ascertained by most valuers is briefly this: A hypothetical or imaginary tenant is supposed to be wanting to rent the works. Here I cannot do better than take from Mr. Newbigging's articles the following, which is an explanation of the mode:—

> In order to ascertain at what annual rent a tenant might reasonably be expected to take a gas undertaking—not on a lease for a term of years, but "from year to year"—it is necessary first to find what is the gross income arising from the hereditament; then the expenses consequent on the working. Then one being deducted from the other, there is left the net receipts. These net receipts constitute the fund out of which the landlord's rent and the tenant's profits are to be supplied. In other words, the net receipts are to be divided between the landlord and the tenant; and the next point to be settled is the tenant-occupier's share of the net receipts. This is done by fixing the amount of capital which he would require to enable him to work the concern. This would include a proportion of the year's expenditure; the value of the coals in stock, and other necessary stores of all kinds; the value of the chattels, such as tools and implements, office and laboratory furniture, and meters on hire; and, finally, a proportion of the annual rent which he agreed to pay. On the sum of the tenant's capital thus ascertained, interest at the rate of 5 per cent. is reckoned; then 10 per cent. for trade profits; and 2½ per cent. for risks and casualties—making 17½ per

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* The proceedings in this matter were reported in the *Journal of Gas Lighting*, Vol. LIII., p. 295.

cent. This percentage, calculated on the tenant's capital, gives the tenant's share of the net receipts, and which, deducted from the same, leaves the "gross estimated rental" or "gross value"—that is, the yearly rent which the tenant would pay for the beneficial occupation and use of the hereditament. Then come the statutable deductions on the landlord's account, for the imperceptible depreciation of the property. These consist of an annual amount assumed to be set aside, and invested at compound interest, for the purpose of the renewal or reproduction of the hereditament—the buildings, apparatus, plant, and main-pipes—at the end of a certain period answering to the average life of the whole; another amount for the renewal of the tenant's fixtures or chattels; and an allowance by way of insurance. The sum of these being deducted from the "gross estimated rental," leaves the "rateable value" of the whole.

Such is the (to my mind) very complicated mode used by most valuers, and one which I think is scarcely fair, as it seems that the best-managed works are thus most heavily rated, whereas a badly-managed works will get off lightly. I am at a loss to understand how a valuer would proceed, using the above method with regard to works making no profit at all, as a great many small gas-works are now doing—a condition to which a great many corporations are also tending.

The best method of dealing with this question is, in my opinion, that which Mr. Carr has placed before us, inasmuch as it would fall equally upon all works—whether they were making high or low profits. Mr. Carr finds that, taking the average of a number of companies, the rates they pay are one-third of a penny per 1000 cubic feet of gas consumed per 1s. in the pound of rate levied. Objection to this mode has been made in several quarters, but not with any substantial ground. If we take the case of a company selling (say) 26 million cubic feet of gas per annum, and work it out by this rule, we shall find that for every 1s. rate they would pay £36 odd; and if this (if it were necessary) were multiplied by 20, it would give us the rateable value of the works—viz., about £720, which is a much more satisfactory figure than some works have at present attached to them. I think I may take it that this way would suit our esteemed friend Mr. Barton much better than that under which he is rated at present; for if we take 70 million cubic feet as the sale at Peterborough (I do not know the exact figures, but that is near enough for an approximate calculation), we shall find that this works out to about £97 for every 1s. of rate levied, or a rateable value of £1940, instead of £3600 as at present. It has been suggested that this method of dealing with the question would affect gas companies very unequally, as in some towns the rates are twice or three times the amount they are in others; and therefore the works situated in the heavily-rated places would have to bear more than in the more lightly-rated towns. This is purely a local matter, and not one which has anything to do with the general principle of this mode of rating. Take, for instance, the case of my own town and one situated three miles from it. With me, the rates are not more than 2s. 6d. in the pound—sometimes less; whereas in the other case they are 8s. or 9s. in the pound.

There is also another way of arriving at the rateable value of gas-works, and one which has been adopted in several instances —viz., taking a certain percentage (say, 4 per cent.) of the capital employed by the company. This mode would perhaps answer very well in certain cases, and possibly some companies would be fairly assessed by it. But I think that in the majority it would be a failure, as some companies are, not through any fault of their own, burdened with a very large capital, and consequently would be assessed very heavily, while others are the reverse, and therefore would get off lightly in regard to the assessment. But the only mode which commends itself to my mind is the one which Mr. Carr has shown us; and until a better one is presented, I should be prepared to stand by it, as I think it fairly meets all cases. No doubt, in dealing with individual cases, faults would be found with the system; but they would be small compared with the other methods mentioned.

In conclusion, I wish it to be clearly understood that, in writing these few remarks, I am not animated with a desire to do injustice to anyone, but am trying to gain the opinion of members of the Association on this important matter.

Discussion.

Mr. BARTON said he quite agreed with the writer of the paper that the present system of valuing gas-works was not at all satisfactory. They had had some little experience with it at Peterborough; and, he was sorry to say, the appeal went against the Company, and brought up their assessment something like 75 per cent., and increased the rates from about 2d. up to 4d. per 1000 cubic feet of gas sold. The existing method of assessing gas-works was, to his mind, a tax on management, because the valuers took the profit that was made. If they had a gas-works which had a large capital, they would be compelled to make a considerable amount of profit, comparatively speaking, to pay the dividend. Take his own case. He had a capital of nearly £80,000, and a make of less than 80 million cubic feet. To pay dividend on the capital and interest on the bond debt, they had to make a profit of about £5600 a year; and this was taken, with certain deductions, as the rental that a tenant would have to pay for the works—the result being that they had to pay on an assessment of £3600, with a gross profit of about £5600. With a rate of between 4s. and 5s. in the pound, a tax was thus imposed on the gas sold of nearly 4d. per 1000 cubic feet. This he did not consider at all satisfactory, because if they had smaller works with less capital, they could produce the same quantity of gas, and would not require to make so much profit. But as they had large-sized works to meet the demands of a growing town, with mains well laid and of large size, in order to pay the maximum dividend they had to make more profit, and were taxed on that. He thought that, if they had some system of taxing gas-works on the quantity of gas made, or the quantity sold, or on the number of tons of coal carbonized, they would then get more equality. He knew that sometimes the price of gas at Peterborough (which was now 3s. 2d. and 3s. 4d. per 1000 cubic feet) was compared with the charge in neighbouring towns; and the people who made these comparisons did not take into account the different circumstances connected with the works, but jumped to the conclusion that the Company were charging more for gas than they ought to do. They did not trouble themselves to know the details; and on this ground, he did not think it was fair that one gas-works should be assessed so much higher than another. Of course, the gas consumers had to pay; but at the same time, it was a hardship on the companies. At Peterborough, they were nearly at the top of the tree as regarded the rates and taxes; and he was sorry to say they had no means of reducing them. He should be glad if some method could be devised whereby the assessment could be based on a proper calculation; so that all gas-works throughout the United Kingdom could be put on a fair and satisfactory footing.

Mr. **Best** said he did not think this question of the assessment of gas-works need trouble gas companies very much, as the money came out of the pockets of the consumers. In his own case, he had a grievance. In the parish where his works were situated, they were not assessed so high as in the one where the mains were.

Mr. **Barton**: The assessment is based on the amount of revenue derived from the different parishes.

Mr. **Barratt** asked what was going to be evolved out of the present discussion. Paper after paper had been read on the subject of the rating of gas-works, of which perhaps one of the best and most intelligent was that which was contributed by Mr. Carr to the meeting of The Gas Institute in Manchester. Was it not time now that some action was taken by the different Associations to bring this matter to an issue? With regard to Mr. Best's remarks, he should not himself like to say that this was a matter which need not trouble gas companies, seeing that the consumers had to pay. This was just where it did matter. It was the consumers who complained; and anything that could be done to reduce the price of gas would confer a benefit not only upon them, but upon the companies themselves. He had himself suffered very nearly as much as his friend Mr. Barton had done. He had tried to ascertain the principle upon which the valuer assessed his works; but this he was unable to do, and consequently they had to fight him. He thought it would be wise if a resolution could be passed to the effect that the Presidents of the several District Associations should meet, and bring together their different views, and see whether they could not devise some proper method of assessing gas-works. This could be brought before the Government; and if possible —and personally he did not think it was impossible—some law on the subject should be enacted. He had no objection to paying his taxes, provided they were assessed in a legitimate manner, and all had to pay according to a given scale. They were in duty bound, in the interest of the consumers, to make a move in this matter.

Mr. VALON said he quite agreed with Mr. Barratt's remarks; and even before that gentleman commenced speaking, he had made a memorandum in these words: "It cannot be altered without parliamentary interference." To argue the injustice or inequality of rating, was quite outside their province. What they wanted to do, in the first instance, was, as Mr. Barratt suggested, to come to some intelligent arrangement among themselves that would recommend itself to the authorities who had to legislate on these matters. By going in the proper channel, and throwing themselves open to examination, he thought there would be little difficulty in convincing the authorities that the present mode of assessing gas and water works, and many other undertakings, was very inequitable, and bore very hardly, not on the companies alone, but on a portion of the public. If it affected evenly the whole of the public, they would have nothing to say, because everyone would have to bear an equal burden. It was because it only affected (say) one-half of the public that it was their duty, as representing that part, to see they were fairly dealt with. The reader of the paper, and the subsequent speakers, were perfectly right in saying that, under present conditions, it was quite impossible to arrive at the true value of the works to be assessed. The profit earned had no reference especially to the investment made. The two things were quite at variance—the profit earned and the value of the hereditament. He certainly thought it was wasting time to attempt to discuss the matter until they had taken the proper steps in order to get it altered.

The PRESIDENT observed that, although they could not alter the system of which they complained, there was not the least reason why gentlemen who had anything to say on the subject should not take part in the discussion.

Mr. BARRATT said he should like to take the feeling of the meeting on the question. Unless they combined, they would get nothing from the movement; and he would suggest that a member should propose a resolution to the effect that the Presidents and Secretaries of the various Associations should meet together, and see if they could not hit upon a plan by which they could move the Legislature.

The PRESIDENT said he was not quite clear as to whether a resolution of that kind would be in order at this meeting. However, he wished to say a few words upon the subject. It seemed to him that there was a great deal more to be said for the principle of the hypothetical tenant than had been said so far. All assessments were based on the rental of the property; and assuming that they could, by the adoption of well-known principles, find what would be a fair and reasonable rental for premises to be assessed, then it appeared to him that they had a fair starting-point, and it would not be a difficult matter to arrive at what would be a proper sum for those works to be assessed at. He was thinking over the matter a few days previously; and it occurred to him whether they could not adopt the principle of making the assessment at per 1000 cubic feet of gas. But this was open to the same objection as the present system; and in the minds of some, it would be a tax upon good management and successful carbonization. Then if they based the assessment upon the amount of capital expended, how would they deal with those works which had provided for extensions for years to come; and where the actual amount of business done yearly was not at all in accord with the amount of capital which had been laid out, and upon which profit had to be made. The whole question seemed to be full of difficulties; and the most practical solution of it which occurred to his mind was that they should have some Court appointed, the members of which should fully understand all matters connected with the gas industry; and let them decide what should be a fair amount of burden for a gas-works to carry. He was sorry Mr. Ward was not present to reply to the discussion, but was sure he would be much interested when he read the report of the debate to which his paper had given rise.

THE STOREAGE OF COAL.

Mr. C. E. Jones (Chesterfield) then opened a discussion on "The Storeage of Coal, viewed with regard to the Combination of the Mining Industries to the Detriment of the Gas Industry." He said that this subject was a very important one, and one to which they, as gas managers, would do well to specially direct their attention, having regard to what was likely to happen in the future. The total area of the coal measures of the United Kingdom was about 6000 square miles, or 4,050,000 acres; this being exclusive of the south-eastern division of England, where coal had recently been found. In 1873, the output of coal was 128,680,131 tons; and in 1890, according to the Government returns, 181,614,288 tons—an increase in eighteen years of 52,934,157 tons, or nearly 30 per cent. (29·20 per cent.), and over the previous year of 4,697,564 tons. The number of mines in 1873 was 3938; and in 1890, 3409—being a decrease of 529, or 13·43 per cent. It would thus be seen that, while the number of mines had decreased, the output had largely increased; and this arose from the fact that small mines were unprofitable to work, and the large mines had increased their power of output. In 1890, the number of male persons employed underground was 531,670; and including the pit top, sidings, and coke ovens in and about the mines, with 5890 females, they had as the total number of persons employed 674,434. The coal industry, it would be observed, was a very important one in this country—employing as it did nearly three-quarters of a million of people, and providing the backbone of the gas industry. The occupation of a miner was now twice as safe as it was formerly. In 1872 there was one death in every 233 persons employed; and in 1890, one in every 543. The general average of coal raised for every fatal accident was 226,023 tons, or 178,227 tons per death resulting from accident. These figures showed a remarkable increase on what took place the first year the Coal Mines Regulation Acts came into operation. Of the 181,614,288 tons of coal raised, he calculated—and he thought he was taking a very low estimate indeed—that more than 12,000,000 tons were used in the manufacture of gas, or about one-fifteenth of the entire output. The number of gas-works in the United Kingdom might be placed roughly at 600, of which 65 per cent. belonged to private enterprise, and 35 per cent. to local authorities. What he wished to direct particular attention to was the combination on the part of the miners and their employers, with the view of forcing up the price of coal. This took place some two years ago, with very disastrous results to the gas companies. He might say that, within a comparatively short period, the price of coal had been advanced all round by 4s. per ton; and he thought he might say that last year and a portion of the previous year, it was considerably higher than that. Now a penny per ton on twelve million tons of coal came to £50,000 a year, which had to be taken out of the gas profits. A shilling a ton amounted to £600,000; and 4s., to £2,400,000 a year. During the combination of miners and coal-owners, no less a sum than 10 millions had been taken out of the gas industry. How was the 4s. per ton divided? He believed that 1s. 4d. went to the collier, and 2s. 8d. to the coal-owners, or 40 per cent. to the one and 60 per cent. to the other. These figures might be taken as reliable, as he was conversant with the prices being paid for getting coal. Now this advance had hitherto been sustained without (excepting in a few instances) increasing the price of gas; but they could not go on like this for ever. His desire was that every gentleman present at the meeting should give his personal experience in this question, in order that they might convince the coal-owners and colliers that the gas industry was not an El-Dorado. With tar falling and sulphate receding, and a rise in the price of nearly every article used in gas-works, this must in the end tell unmistakably, and very injuriously indeed, upon the future of their industry. They all rejoiced most heartily when they heard of the amelioration of the material and social condition of the working classes. The colliers undoubtedly deserved all they had obtained; but having received an advance of 40 per cent., they ought to be satisfied. There were, however, rumours of strikes, other combinations, shortening of the hours of labour, and a reduction of the output; and these things it would be well for gas managers to take note of, and, if possible, to meet the circumstances under which they found themselves. Coal was no doubt an indispensable national article; but what was to become of kindred trades if these combinations were to lead to a prohibitory price? Already there was a shrinkage in some of the trades of this country—notably in the iron trade; and as history in all ages had a peculiar "knack" of repeating itself, bad times would come upon the country again if they had to depend upon the coal-owners for their assistance. Gas managers could not now be sure of getting their coal regularly from the contractors; and they were always making stereotyped excuses. Some three days a week was now about the time a collier took to earn what he used to get in six days. His object was to have less to do, and yet earn the same amount of money. The latest fad was for an eight-hour day. But how was an eight-hour day to have legislative enactment. If it had, it must be applied alike to all the country—to doctors, railway men, fishermen, sailors, hospital nurses, and others. The working men of this country had done more than any other .people to encourage the importation of foreign labour, by being led by the nose by faddists. With these evils staring them in the face, gas managers must conduct their affairs economically; and in order to get peace and comfort, it was absolutely necessary that they should have a store of raw material always at hand, and a storeage largely in excess of what they used to consider necessary. The six weeks' storeage of the old orthodox times was now no longer applicable; and he would be a rash man who would not make provision for a larger quantity than this. He thought that, if the present state of things continued, they would have to provide for one-third of the total year's consumption of coal, which would mean an increase in cost if it was purchased from a contractor. This would mean an increase in the cost of the manufacture of gas; and this would mean, following the corollary, an increase in the price of gas. But if they attempted to increase the price, they would have an enlightened public up in arms immediately. One word of warning to the coal-owners. Owing to the high price of cannel, it had almost been superseded in the South of England as an enricher of gas; and bituminous coal would follow, unless great care was exercised on the part of the coal-owners and the leaders of the colliers. The advent of oil as an enricher of coal gas and also of water gas was enough, he thought, to cause the upward movement with regard to coal to pause. It should be a matter of serious consideration for the coal-owner as to how far he could squeeze the gas industry, or how far he would encourage the importation of oil and the manufacture of water gas. That this would injure the coal industry went without saying. He hoped these words of warning would be taken up by those to whom they were addressed, and that nothing more would be heard of attempts to force up the price of coal. In the face of interruptions in the railway and canal traffic, strikes, holidays, accidents, frosts, &c., which increased the responsibility of the gas manager, it was absolutely necessary that he should at once secure ample storeage under cover.

Mr. **Duesbury** said there was no doubt about it that the time had come when gas managers unfortunately had to get in larger stocks of coal than they had been in the habit of doing; and this entailed additional expense. He hoped the price of coal would recede somewhat. If it did not, it would be a very serious matter; and the price of gas would necessarily have to go up. Mr. Jones had referred to the use of oil by the London Gas Companies for enriching their gas in the place of cannel; and if the price was not reduced, other gas companies would have to take similar steps.

Mr. J. T. **Jolliffe** (Ipswich) said he did not take quite such a pessimist view as Mr. Jones as to the combination of coal-owners and miners, nor did he think it was necessary to have a stock of coal so large as had been mentioned. He thought it would be better to pay a little more for coal than to spend a considerable amount of money on coal-stores, and with the risk of firing and other incidental troubles involved in having a large stock. At the same time, he thought it was desirable to have a fairly good supply of coal in hand. This year coal had been bought much cheaper than last year; but he believed that, whatever the price of it might be, they would have to depend in future very largely upon the state of the trade of the country as a whole, and more especially upon the state of the iron trade. Many present knew that for years the coal-owners did not earn a penny of profit; and this was not a healthy state of things. He did not say they were to make a fabulous sum of money; but certainly gas companies who had year after year paid maximum dividends without much trouble, now that dark days had come upon them, should not raise the hue and cry of absolute despair. If necessary, they should advance the price of gas to pay dividends; but this should only be done as a last alternative.

Mr. A. **Mitchell** (Bury St. Edmunds) said that he should like to make a few remarks on this particular phase of the question: A great many of the members were managers of comparatively small works, and used all inland coal. The experience of most of them was, he believed, that they had too little storeage room; and they would find it of considerable advantage if they could store a great deal more coal than they were now able to do. They were guided to some extent in what they did by their directors; and if the latter would only allow their managers to buy more coal earlier in the season, and have more storeage in the winter, it would benefit all concerned. He was afraid many small works had not even six weeks' storeage, while they ought to have at least twelve. There was no reason why small works should take in but very little coal from the middle of November until February; and the coal they had to use would then be dry and much cleaner.

Mr. J. W. Helps (Croydon), in reply to an invitation from the President, said this coal-supply question had not affected his Company so far to any great extent, because they happened to have a contract which had carried them on to the end of last June; and now that the price had gone down, they had been able to get a contract at a figure a little above the old one. Unfortunately, they were placed in the position of having storeage room for only 6000 to 7000 tons of coal, which merely represented about five weeks' supply. Though as a rule he was not favourable to middlemen, they did not buy their coal direct from the owners; but they had a contractor who, in the event of their not being able to get coal from the pit which they contracted for, could give them either inland or sea-borne coal. He rather agreed with the remarks made by Mr. Jolliffe, that it was not necessary to go to the extent of four months' storeage, as proposed by Mr. Jones; but he was of opinion that two months' stock should be the minimum. As to the question touched upon by Mr. Mitchell, with regard to the delivery of coal during the winter, his remarks were perfectly right. In his (Mr. Helps's) case, when he had his coal-store quite full, he merely asked the contractors not to stop their deliveries, but rather that the amount of coal coming in should be about sufficient to carry them on from day to day without decreasing the quantity they already had. It seemed to him that if the gas-companies promised to take a larger amount of coal during the summer, the coal-owners would make a reduction in price (say) up to the end of October. He believed, however, it was the case with many contractors that, if they knew a company's stores were full, and they (the contractors) happened to be pushed in the winter, they would take advantage of it, so that the company would really be in no better position than if they had not stored coal in the summer. As to the use of oil for enriching gas, there was no doubt that the tendency, at any rate in and around London, was to do away with cannel. He had himself given the subject some study; and, on his advice, at their last meeting his Directors had given an order for a set of apparatus which, he hoped, would supersede the use of cannel.

Mr. **Wimhurst** suggested that, as there were two representatives of colliery-owners present—Mr. Taylor and Mr. Fincken—it would be interesting to hear them on the subject.

Mr. **Taylor** said that, for about eight or nine years previous to two years ago, colliery-owners actually lost on their transactions. But during the past two years they had made money; and he was very glad they had. He hoped that these sudden changes would bring about some kind of system, whereby both gas companies and colliery-owners would receive a fair amount of dividend on the capital they had invested in their concerns. He thought that if a Committee were appointed on behalf of colliery-owners and gas managers, they could come to some kind of arrangement by which the latter would take the coal as it was drawn out of the pits. He certainly could not see why gas companies should expect the colliers to work only two days a week in the summer, and six-and-a-half in the winter. He had had contracts where he had to deliver 2½ per cent. in the months of May, June, and July, and had been called upon to deliver 15 per cent. in December, January, and February; and from his experience of 22 years, he found that gas managers always pressed him more in December than in any other month.

Mr. **Fincken** said Mr. Jones had stated that there had been a rise in the price of gas coal of 4s. per ton, which represented to the gas industry a total sum of £2,400,000; and of this 4s., he asserted that 1s. 4d. had gone to the men, and 2s. 8d. to the masters. His (the speaker's) experience had been with one or two of the Silkstone collieries; but he entirely failed to see where this 2s. 8d. had been obtained. Up to the year 1888, collieries were actually losing from 8d. to 9d. per ton of coal; and instead of the 2s. 8d. referred to by Mr. Jones, the figure should now only be 8d. As to the difficulties with the men, Mr. Jones lived in a colliery district; and he was in a position to appreciate the trouble they had had with them as well as he (Mr. Fincken) was, especially with the younger men. He could not at all see the reason why this question should have arisen now; but if the subject of increased storeage had been brought forward two years ago, he could well have understood it, as, of course, it was now well known that prices were falling. Then Mr. Jones said there was a combination of the colliery-owners and the men; but there was no such thing—in fact, they were "at daggers drawn." If gas-works owners had lost the 4s. per ton on their coal, and were still able to pay their dividends, this showed that, in past years, they must have had very rosy times indeed.

The PRESIDENT said that he questioned the wisdom of attaching such great importance to momentary combinations of either coal-owners or their men. No doubt, these arrangements were productive of a good deal of inconvenience to those who happened to be in the market when they were in full swing; but, in the very nature of things, they did not last long, and would soon right themselves. He was quite with Mr. Mitchell when he said that it would pay gas companies far better to spend a little more capital on storeage, so that they could put coal under cover, than to be content to go on year after year with limited storeage, and be exposed to the danger of waiting for supplies, and having to go into the market to buy coal at something like panic prices. He was of opinion that if they provided for six weeks' maximum storeage, they would be in tolerably easy circumstances, and would get through some extraordinary winters without any difficulty at all.

Mr. JONES, in reply, said there was no doubt the coal-owners had recently mended their ways somewhat. But they had given no guarantee whatever for the future, and therefore it was just as well that gas managers should keep their eyes upon them. Although situated right in a coal-field, he had been within his last 24 hours' supply of coal, owing to strikes, the congestion of the railways, and the inability of the masters to compel the men to work. As to paying colliery-owners for coal rather than erect additional storeage room, he thought this was a very visionary notion, because they could not make the men work; and the output was regulated more by the whims of the men than by the wills of the masters. He thought it was generally recognized that the coal storeage of gas-works was insufficient, taking the country all round; and he did not think that three or four months' storeage was at all outrageous. Besides, there was the important point that coal stored in the summer was much better for gas-making purposes than that delivered in the wet and snow of the winter months. As to taking the coal as it was obtained from the pits, he pointed out that it was not drawn from them in anything like regularity all the year round; but there was something in the idea, as they were more likely to get the coal in a dry and good condition. He could not admit that, for some eight or nine years, colliery-owners were losing 8d. or 9d. per ton, though he agreed that collieries were not so remunerative as they might be. But, on the other hand, there were also scores of gas companies which for many years never paid any dividend at all to their shareholders. It was asserted that there was no combination between the coal-owners and the men. Of course there was not; but it could not be denied that there was a tacit understanding. As to the profits of gas companies, these were not at all enormous; and they had to publish a statement of their accounts, which was overhauled by Government auditors. The colliery-owners were under no obligation to do this; and they now made 20, 30, and, in one instance he knew of, upwards of 200 per cent. In conclusion, he repeated that six weeks' storeage was utterly insufficient; and it should be quite as much as he had advocated in his opening remarks.

On the motion of Mr. R. J. SHARMAN (Wisbech), seconded by Mr. C. J. WRIGHT (Saffron Walden), a vote of thanks was passed to the readers of the papers and to Mr. Jones.

ELECTION OF OFFICE-BEARERS.

Mr. BARRATT moved, and Mr. BEST seconded, the appointment of Mr. C. E. Jones as President for the ensuing year.

This having been unanimously carried,

Mr. Duesbury was elected Vice-President, on the motion of Mr. BARTON, seconded by Mr. YORSTON.

Mr. Wimhurst was re-appointed Hon. Secretary and Treasurer; and the Auditors (Messrs. Weller and Yorston) were also re-elected.

These gentlemen having acknowledged the honour conferred upon them,

Mr. WELLER observed that they were in the happy position of having a balance of £25 in hand; and he had much pleasure in proposing that an honorarium of ten guineas be presented to their Secretary, as a slight recompense for the great trouble he had taken in furthering the interests of the Association.

Mr. YORSTON having seconded the motion, it at once received the hearty approval of the members.

Mr. WIMHURST, in returning thanks for this kind recognition of his services, mentioned that, when the Association commenced, they had only 24 members, but now there were 53.

Mr. W. J. Carpenter (Yarmouth) and Mr. J. H. Troughton (Newmarket) were elected members of the Committee in place of Messrs. Jones and Grimwood, who retired by rotation.

PLACE OF NEXT MEETING.

The question of the selection of a town at which to hold the next meeting gave rise to a little discussion; and eventually it was decided that Sleaford should be visited.

VOTES OF THANKS.

A hearty vote of thanks having been passed to the Mayor of

Cambridge for allowing the Association the use of the Council Chamber for the meeting,

Mr. A. DRAGE (East Dereham) moved a resolution acknowledging the services of the Auditors and the Committee during the past year.

Mr. DUESBURY seconded the motion, which was carried.

A similar compliment was then paid to the President, on the motion of Mr. C. DIXON (Horncastle), seconded by Mr WRIGHT.

The PRESIDENT briefly responded; and this concluded the meeting.

The remainder of the afternoon was spent by the members and friends in visiting the Senate House, and King's, Clare, Trinity, St. John's, and Jesus Colleges; the Mayor and Mr. Duesbüry kindly acting as guides. The gas-works were also inspected; and the day's proceedings were brought to a close by a dinner at Y^e^ Old^e^ Castel Hotel.

NORTH OF ENGLAND ASSOCIATION.

HALF-YEARLY MEETING, OCT. 3.

This Meeting was held at the Offices of the South Shields Gas Company—R. Wallis, Esq., J.P., Chairman of the Company (the President), in the chair.

The members and friends assembled at the works of the Gas Company, where the Engineer, Mr. W. J. Warner, and his assistant (Mr. Wood), courteously received them, and showed them round. The works were originally constructed for an output of about half-a-million cubic feet daily; but at the time of the visit they were being worked up to a million and a quarter feet per diem. There were 189 retorts, in settings of seven, ranged in two benches—a single and a double; and though the method of firing was that of the old direct furnace, there was a peculiarity in Mr. Warner's setting by which he obtained much of the advantage which others derive from regenerative firing. The other plant includeed two Gwynne and Beale exhausters, two of Parkinson's station meters, and a Feldmann's sulphate plant, capable of producing 10 tons of sulphate a week.

The business meeting was held in the Board-room; the President (who had occupied the chief position in the Company for more than thirty years) taking the chair shortly after noon.

A Welcome to the Town.

Mr. Councillor Smith, in the absence of the Mayor, briefly welcomed the Association to South Shields; remarking that he knew their deliberations were for the advantage of the members and of the public at large.

The President, on behalf of the Association, thanked Mr. Smith as the representative of the Mayor and the Directors of the Gas Company. He himself, he said, occupied the same dual position as Mr. Smith; and he knew very well the interest that was taken in their meeting by both bodies. They considered the visit of the Association as an honour to them.

New Member and Associates.

Mr. B. W. Richardson, of Harrogate, was admitted a member of the Association; and Messrs. L. H. Armour, C. E., of Gateshead, and T. Gibson, of Carlisle, as associates.

The PRESIDENT then read the following

INAUGURAL ADDRESS.

Gentlemen,—I will not stay to inquire why you have done me the honour to appoint me your President. It is a post more fitly due to gentlemen who, by their scientific and practical abilities, have distinguished themselves by promoting the special interest of your Association—that is, the manufacture and distribution of coal gas.

I am not disposed to question the liberal spirit which prompts the admission amongst you of those who have neither scientific nor practical abilities, but those also who have taken, for a long period, an anxious and active interest in the administration and financial management of this great industry. Gas manufacture has always been a subject of lively interest to me. I am, I believe, not only one of the oldest in years, but one of the oldest in official connection with the gas interest throughout the whole area embraced by your Association—in that respect, gentlemen, an unenviable position. But I accept the position with thankfulness and humility. It is the one, the only one, which has brought me the rich reward of being chosen your President; I have no other qualification. What little science I might once have had, became long ago obsolete.

I remember well, when Provincial Gas Associations were first contemplated, having long and anxious discussions with one of your present and most active members, about the judiciousness, and probable success, of separating ourselves from the parent society—the great national "Gas Institute." At that time, I argued that "Union is Strength," and advocated no falling away from the parent society. But, gentlemen, from careful observation during all the years that Provincial Associations have been in existence, I am now satisfied that I was wrong. After all, there has been no real separation between the parent tree and the branches. We have a proof of this in the fact that one of our own distinguished members had this year the honour of being President of The Gas Institute.

I will not allude to the trouble and annoyance that befell the parent society a few years ago, further than to express the liveliest satisfaction that the Institute has regained the confidence and goodwill of all right-thinking men, and its old influence over the great interest it represents. The only change that I can see is the abolition of "Innocents Day." Many valuable papers which were designed to be read at the annual meetings of the Institute, were postponed, and lost to the public for want of time. They are now read and discussed at the different Provincial Associations, with credit to their authors and to the dissemination of useful information.

Since the commencement of the present century, what wonderful development of inventive genius we have witnessed! The world, as it were, encircled with an iron girdle; ships (such as our forefathers had no conception of) now plough the pathless deep at the rate of 20 miles an hour—thus annihilating space, extending beyond all conception the trade and commerce of the world, and bringing all nations into kin. Amongst the many other great conceptions of inventive genius the century has produced, is the art of manufacturing coal gas—"an art that does mend Nature." It was first publicly introduced on the memorable occasion in our Nation's history at the celebration of the Peace of Europe in the year 1802, by Mr. Murdoch—the undoubted promoter of the manufacture of coal gas for public lighting. And I will ask you, gentlemen, to endorse the noble sentiments in the presidential address to the parent society at Carlisle, to lose no time in wiping out the stain (I will not say on the gas interest, but on the Nation at large) that no fitting memorial should ever have been erected for a man who has done so much to promote the prosperity, happiness, and comfort of the civilized world.

These are no mere words of rhetoric, gentlemen. The science of coal gas manufacture has dignified labour; it has raised up a class of mechanical engineers and natural philosophers, not to be surpassed in any other art or science; it has added a new direction to the science of chemistry; it has been a fruitful field for the surplus capital of this rich nation; and yet there is no memorial to mark the Nation's gratitude to so great a benefactor. Mr. Murdoch had previous to 1802—in 1798—made many private experiments. But the inauguration of public gas lighting dates from the first public exhibition in 1802; though it was not till the year 1810 that the first Act of Parliament was obtained by the London Gaslight and Coke Company, with a capital of £200,000. In the year 1812 they obtained their Charter. In 1816 they had again to apply to Parliament for an increase of capital to the extent of another £200,000. One grave mistake they made, which, I believe, is not an uncommon one at the present day. They laid their mains too small, and had to replace them with larger ones. By this time coal gas had gained the favour and confidence of the public. It had overcome the powerful opposition and interference of private interests; it had overcome the inveterate prejudices of its opponents, and the ungenerous rivalry of the London and Westminster Oil-Gas Company; it at once became a financial success, and has continued so till the present time. Oil gas, on the contrary, although generally established in the year 1817, and incorporated in the name of the London and Westminster Oil-Gas Company, was supported by the leading philosophers of the day—Congreave, Brande, Faraday, Ricardo, &c.—with a capital of half-a-million, and adopted by the incorporated Companies in Edinburgh, Liverpool, Manchester, &c. In the laboratory experiments it gave 3½ to 1 in brightness and purity over coal gas; and yet in a few years all the companies came to ruin. We have heard very little about oil gas from that time until we hear that The Gaslight and Coke Company, owing to the high price of coal, are at present supplementing their make of coal gas with a portion of oil gas. It will be interesting to know the results.

From that time (until the electric light threatened to extinguish us), by the rapid and scientific improvement in manufacture, purification, distribution, the utilization of the residuals, and the many other purposes coal gas can be applied to, it has maintained undisputed possession of public favour. I know of no other commercial pursuit that has had such a rapid and successful career. As early as the year 1827, no less than 200 of the large cities and towns in the kingdom were lighted with coal gas—the South Shields Gas Company among the number, as our first Act of Parliament was obtained in 1824; and at the present day, there is not a town of any importance in the kingdom but has its gas company.

The yearly increase in the use of gas throughout the kingdom is enormous; necessitating a yearly increase of capital. As I have mentioned before, the first company that obtained parliamentary powers was The Gaslight and Coke Company. Their capital from 1810 to 1816 was £400,000; their capital is now, in round figures, 12 millions of pounds. It is the largest gas company in the world. By the last parliamentary returns, the capital employed throughout the kingdom is 96 millions. But this is not all. Gas speculation has become a speciality with English capitalists. English coal, English capital, and English engineers of scientific and mechanical ability have established the manufacture of coal gas in the furthest limits of civilization.

This, gentlemen, is our inheritance! We must guard it with all our might and ability. It is true we have not the same chances of distinguishing ourselves as our predecessors had. They have brought the science of gas manufacture to nearly perfection But there is no finality. There are giants in these days, whom it would be invidious to particularize; and who can tell what further wonderful discoveries may be made in the distillation of coal?

In matters of detail, I would commend to your attention the subjects of mechanical stoking, the amalgamation of companies—both for the manufacture of gas and the treatment of residuals by the companies themselves—the best methods for popularizing and promoting an increased consumption of gas for other than lighting purposes, and the assembling of ourselves together to read and discuss papers on practical subjects. Whether or not there may be any great and startling discoveries for us, in our time, from the high state of working order the industry has been brought to, with careful attention to detail, we ought to be able to hold our own against all comers, to continue to command the confidence and good will of the public, and to maintain the commercial value of the undertakings.

Mr. J. HEPWORTH (Carlisle) said he thought they should express their opinion as to the admirable address to which they had just listened. He was sure he carried the feeling of everyone with him when he asked them to award a hearty vote of thanks to their President. Whatever Mr. Wallis might have felt as to his being requested to preside over the Association, he could assure him that the members felt it to be a higher honour to them to have had the opportunity of meeting under his presidency. Those of them who had known Mr. Wallis—and some of them had been acquainted with him for many years now—knew how intimately he had been connected with the gas industry of South Shields; and though he had spoken regretfully of his want of knowledge of scientific methods, they all knew that he was one of the first to introduce them for the manufacture of gas, and that the South Shields Gas Company were largely indebted to the ability which he had exercised as Chairman. He might be permitted, as the Past-President of The Gas Institute, to thank Mr. Wallis for the exceedingly kind words he had spoken of that organization, and he trusted that the useful work of the Institute, and of the kindred Associations to which he had referred, might go on and increase. Whatever room there might be for further improvements in the manufacture of gas, nothing would encourage them more to promote these than the words they had just listened to.

Mr. W. **Hardie**, jun. (Tynemouth), seconded the proposition, which was carried.

The **President** said he was exceedingly gratified with the way in which they had thanked him for his very imperfect performance of his duties.

Mr. L. H. **Armour** (Gateshead) then read the following paper:

A SIMPLE METHOD OF PREVENTING STOPPAGE IN ASCENSION-PIPES OF GAS-WORKS.

In dealing with a well-known problem, it is not possible to avoid references that are familiar to all concerned in the processes of an ordinary gas-works; but I trust also to add thereto certain facts of importance in the working of a gas plant.

The choking of ascension-pipes by the rapid deposit of pitch, is a common mishap in most gas-works. It is generally admitted that the higher the temperature at which the fires are maintained, the greater is the tendency of the pitch to form; while bends, the smallness of the diameter of ascension-pipes, or their nearness to the brickwork of the retort-bench aggravates the case.

Among the attempts to cope with this tendency may be mentioned: (1) The placing of a large piece of coal in the mouthpiece just before shutting the door. (2) The placing of a pannikin of water similarly. (3) The dishing out of the under lip of the mouthpiece, to hold the early condensation of liquor. (4) The trimming of the charge in the retort so that there is the greatest body of coal nearest to the mouthpiece. (5) The forming of an internal annular space round the lower part of the ascension-pipe, to catch the liquors condensed in the early stage, to be evaporated at the later stage. The object in all these appears to be to secure, during the later periods of carbonization, products which usually are driven off early in the process.

A short account of how I was led to what I believe to be not only a sound, but a simple means of preventing the deposit of pitch in ascension-pipes, may be quite as interesting as any line that I could follow. Last summer I was appointed to continue experiments in obtaining residual products from coal in the ordinary process of coking. These experiments had been in hand for some years; but a difficulty which stood in the way of effective work in any direction was the persistent and rapid formation of pitch in the piping used. Briefly, the mode of operation consists in exhausting a portion of the gas evolved in the process of coking by gentle suction through small openings in the oven floor into a hollow under it, from which hollow a horizontal pipe, corresponding to the ascension-pipe of a gas-works, leads into a larger pipe acting as a hydraulic main, whence the gas is drawn through a set of condensers.

A portion of the first pipe is laid underneath the floor of the oven, and only protected from the heat by a few courses of brickwork. Naturally, the floor becomes highly heated after a few charges have been coked; and as soon as the effluent vapours come in contact with the hot metal pipe, the pitch is deposited thereon and hardened. While the floors were new, and before they had become thoroughly heated, a satisfactory yield of products was obtained; but with the warming up of the floors came the formation of pitch in the piping, and the gas no longer found effective vent in response to the suction.

The oil obtained after the outlet had become obstructed, had an appearance which the men in charge described as "burnt." In order to counteract the evil effects which I believed arose from the very high temperature of the floor, I introduced a small drip or trickle of water into the hollow under the oven floor, and kept it flowing as long as the suction was applied. The effect was immediate. The outlet-pipe no longer took on a deposit of hard pitch; and when I afterwards used ammoniacal liquor, resulting from the process, for the drip (in place of ordinary water), the deposits previously formed in the main were softened, and began to flow.

After experience of the effect of a minute quantity of liquor in preventing the formation of pitch in the piping above described, it was an easy inference that the analogous difficulty in the case of gas-works piping would be overcome by the same means. I have the satisfaction of being able to confirm this by the actual application to a setting of retorts at Carlisle, kindly carried out by Mr. Hepworth; while Mr. Warner has a specimen fitting to a retort in his works at South Shields.

I may as well explain that there is no lack of liquor from the gas drawn down from a coke-oven; the quantity sometimes exceeding 40 gallons per ton. So that, adding the drip looked like a needless addition to an already abundant product; but the fact remains as to the invariable effect of the added water. In a set of a dozen ovens, all exhausting into one main and at different stages, the early moist vapour from the charge of one oven seemed to have no effect on the later and drier vapour of its almost completely coked neighbour; and only after introducing the drip was the pitching in the main checked.

The requisite apparatus consists of an overhead tank, which may be kept full from the town water supply by a ball-tap; but the effect of the crude ammoniacal liquor shows its use to be preferable. From this tank a pipe running along the front of the bench carries a tap for each mouthpiece. As the latter is fitted with a sealed inlet, to receive the drip from its tap, it will be obvious that this provides a sight feed, the rate of which is open to instant inspection; and with the set of drip taps all at one level, a look along suffices to show how each is working.

The unmoistened vapours from the coke-ovens not only deposited pitch in the first or outlet pipe, but the other piping was also affected in a similar way. I have already referred to the analogy between the coke-oven piping and that used in a gas-works. This analogy runs also to the behaviour of the tarry products; for where the tendency of pitchy deposit in the ascension-pipes of a retort is greatest, there also clotted and sluggish tar is to be found affecting the seal of the dip-pipes in the hydraulic main, and by adhesion and defective flow in the condensers, reducing their efficiency. As the unequal texture of the condensed tar, in whatever part of the plant it arises, is from the same cause, that which corrects this feature, where it is most strongly marked, will also act advantageously elsewhere. In other words, that which clears the ascension-pipe will also cause the tar condensed in other parts of the plant to flow readily.

Having thus briefly stated the process by which I arrived at this method of using ammoniacal liquor for this purpose, and for which letters patent have been obtained, and having laid before you the evidence of its efficiency, I may conclude by referring to the more obvious results arising therefrom. These are: (1) The prevention of back pressure from stoppage in the ascension-pipes, thereby not only allowing the newly-formed gas free vent, but removing an important cause of the formation of carbon on the inside of the retort. (2) Freedom to use the highest attainable heat without fear of stoppage from pitchy deposit in the ascension-pipe. (3) Less liability of the tar resulting from the use of this appliance to clot in the hydraulic main and elsewhere. These points, with the other relative advantages arising incidentally, will, I trust, commend the device to your favourable consideration.

Discussion.

Mr. W. **Hardie**, jun., said he did not rise with the intention of saying much on the important subject before them, but more for the purpose of asking a question. The question of stopped ascension-pipes was one which had been foremost, he might say, for all time. That there were cures for the evil, he thought most of them would admit. But, in the majority of cases, it was found that the cure was worse than the disease; and, besides, they often involved a great amount of expense and trouble. Mr. Armour spoke of using ammoniacal liquor in place of ordinary water; and the question he wished to ask was why he did so. One would quite see that ordinary water would evaporate in the mouthpieces, and keep them cool; but he did not see what advantage was to be gained by supplying ammoniacal liquor. If Mr. Hepworth or Mr. Warner, who had had this plan in operation, had used ammoniacal liquor, he would like to know what advantage they had gained from so doing. It seemed to him that they would lose a quantity of ammoniacal liquor, and that before it entered the mouthpiece at all, most of the ammonia would be driven off.

Mr. J. HEPWORTH did not think he had suffered quite so much as some of his brethren from stoppages of ascension-pipes. But he knew something about them—in fact, too much; and he also knew something about the remedies that had been used to prevent them—in some cases, with very little success. He was not responsible for Mr. Armour's paper being read; but he was responsible for making the experiments at his own works to which Mr. Armour had referred; and if he told them the success or otherwise that had followed the use of the arrangement, it might perhaps lend some little interest to the paper. The fittings which had been described were exceedingly simple in character, and inexpensive; and unless Mr. Armour placed a royalty on it (of which he as yet knew nothing), the cost of the invention must needs be small. With respect to the efficiency of it, he was bound to say, first of all, that he fitted up the arrangement to one or two ovens; but as he did not work on Sundays, he found that on Mondays there was always some little difficulty in getting the apparatus to operate again. The cessation in the working probably caused the inlet for the water to fill up in some way; but when it was worked continuously, there was no trouble of that kind. There was another slight difficulty; but he thought this lay with himself, and not with Mr. Armour. The seal was sometimes displaced; but on making it a little deeper, it was remedied, even with the stoppage on Sundays. He had no trouble whatever now; and in an ordinary setting, fitted in the usual way, the thing went successfully from month to month, with the effect of preventing all stoppages. He did not think, however, this was a sufficient test to apply, because he was not troubled before with stoppages, although he employed high heats. He had several settings which worked at very high heats—there would be no difficulty in working them off in four hours, though, as a matter of fact, they worked them off in five hours. Until a week or two since, he was repeatedly troubled with stoppages in these at the top; in one setting, he should say no less than eight or ten times in 24 hours. This was a great nuisance, because, whatever good effect he was getting from the high heats, he was suffering a good deal of loss in the stoppages. He accordingly applied Mr. Armour's arrangement to this setting. It had been at work now for nearly a fortnight; and instead of having eight or ten stoppages in 24 hours, he had not had one. There was a little matter that was not perfect. The stoppages at the top had ceased; but there had been one or two slight obstructions just at the point where the gas passed from the retort. He expected, however, that when they had found how much water they needed, they would get over this. The difficulty was not a serious one. By simply putting up a jumper, it was opened; and the retort went on again. It had only happened once or twice in 24 hours; and this in retorts heated up to a very high degree. He had had no experience in the use of ammoniacal liquor; but he should think it might be explained in Mr. Armour's case by his making it at his coke-ovens, where it was very poor and of little value. There was one thing, however—the water was connected directly with the main, and the pressure somewhat varied; whereas, if the water were delivered from a cistern, the last difficulty in making Mr. Armour's method perfect might perhaps be removed. He ought to have mentioned that, in these very highly-heated retorts, the coal used was of a rich character. It was the richest cannel they had; and it was quite possible that, if coal had been used and not cannel, no stoppages would have occurred. Such as there had been were very slight; and he felt that probably another week's experience would enable him to remedy them.

Mr. J. Hall (Chester-le-Street) said that gas managers, rom the start, had had a great deal of trouble from stopped ascension-pipes; and it was a very annoying thing. It was, besides, very difficult sometimes to know what was really the cause of these stoppages. He might mention a great number; but it was perhaps useless, because there were gentlemen present who knew probably more about them than he did. He thought he saw the object of Mr. Armour's plan. Mr. Hardie did not know the difference between using town water and ammoniacal liquor.

There was a vast difference; and they experienced it in scrubbing gas. Sometimes water contained lime, which would cause a stoppage; but in ammoniacal liquor there was no lime. He had recently found out a simple process for dealing with stoppages at the first socket. In one setting he had, strange to say, only a single pipe which annoyed him. He found that one of his men, instead of drawing the charges fully, drew only half, and put fresh coal at the front. This started that pipe; and he had never been able to get it properly cleared. He found that stopped pipes could be burnt out by putting up them a heated 2-inch pipe and an iron rod.

Mr. D. Terrace (Middlesbrough) said he had listened with very great pleasure to Mr. Armour's paper, although, he might say, he disagreed with him on almost every point. This very complicated arrangement to every bend of the ascension-pipe seemed to him to be unnecessary. What appeared to him to be essential was to prevent stoppages rather than to cure them. The cause of all the trouble was the hydraulic main. Remove it, and everything would be right. This was his experience. Mr. Armour's arrangement he looked upon as "pottering" with the thing altogether. About twelve years ago, he (Mr. Terrace) introduced water into the hydraulic main. He was in a gas-works recently where there were hundreds of ascension-pipes; and there was a little arrangement at the top of every one for running water down them. He learned from the manager that since he had adopted this means of keeping the seal clear, there was no necessity for putting a single drop of water into the ascension-pipes. Therefore he considered that the arrangement which had been put before them was going the backward way to remedy the evil; because, if they kept the liquor in the hydraulic main, then there would be no necessity for using it. It seemed that the cooling effect of running cold water in had more to do with the prevention than anything else. But then, if they used cold water, they would weaken the ammoniacal liquor; whereas if they put in ammoniacal liquor, it would find its way to the tar-well. He was going to ask if any augering was required from the mouthpieces every time. He would be very pleased to show any gentleman the method he had had in use for the past twelve years.

Mr. W. J. Warner (South Shields) said that Mr. Armour had mentioned the fact that he had been in possession of one or two mouthpieces at the South Shields Gas-Works for a day or two. These had been entirely in Mr. Armour's hands; and therefore he (Mr. Warner) was not in a position to say what the result had been. The stoppage of ascension-pipes came, he believed, from irregularity of working, and from nothing else. This was a position which he took up a good many years ago, when the subject was very frequently brought before them at their parent institution. Among the various schemes which had been introduced for the purpose of preventing stoppages, there was one especially which they thought a few years ago was going to take the golden medal. It came from Ipswich, and was a grand scheme of elaborate perforated plates, put in the mouthpieces, which screened the gas as it passed away. He then held, and he held still, that the stoppage of ascension-pipes was due to irregularity of working—the result of the retort getting excessively hot, by changes of coal or other cause. He found the stoppages took place most frequently in retorts where the charge was exhausted soonest. He therefore thought that, if they let the gas go off at a good working temperature, there would be no stoppage of ascension-pipes.

Mr. T. Bower (West Hartlepool) did not think he could add a great deal to what had already been said regarding stopped ascension-pipes. He believed the members were all agreed that they were about one of the worst evils connected with gas-works. He was pleased to be able to state that latterly he had not had much trouble with them. Some eight years ago, they had, at the works with which he was now connected, an old bed of retorts which had been in use for nearly twenty years; and in some parts of them, they were very much troubled indeed with stoppages, chiefly in the bridge-pipes. When he examined these, he found that they were not equal in area to the ascension-pipes; and consequently they had the stoppage where the contraction existed. He put in new bridge-pipes, of larger area; and since then not one had been stopped. In this bench he erected one setting of patent regenerative furnaces. It was a setting of seven; and one retort was immediately over the fireplace. This retort gave a good deal of trouble; the ascension-pipe stopping, not only at the mouthpiece, but right up to the top. He passed cold water in by means of a ⅜-inch cast-iron pipe, allowing it to trickle down the pipe. A friend advised him to take out the iron pipe, and to put in a steel one. He did so; and he did not think he had ever had a stopped pipe since. He supposed it was the extra heat in consequence of the retort being over the fireplace which was the cause of the stoppage. Another reason probably was that the retort-house was narrow; and being anxious to have the longest possible retort in, the ascension-pipe was placed close to the bed.

Mr. Hepworth remarked that at his works the whole of the hydraulic main had been supplied with water for some years past; but, unfortunately, this had not cured occasional stoppages of the ascension-pipes.

Mr. Terrace asked if the water was run continuously into the hydraulic main, because that was what he referred to.

Mr. Hepworth replied that it was changed every six hours.

Mr. Armour, in reply, said that, at the beginning of his experiments, he used water; but it was exceedingly hard, and had a tendency to coat the pipe. The ammoniacal liquor which he employed was weaker than most ammoniacal liquors which were produced from coal in the ordinary process of gas making; and when he began to use it instead of water, it kept every pipe clear. He discovered, accidentally, that the effect of the ammoniacal liquor upon the pitch already formed in the pipe was much greater than the effect of clean water. The liquor was the crude or first liquor, such as they would take from the hydraulic main in a gas-works. Now, ammoniacal liquors from the hydraulic were not clean waters with a flavour of ammonia. They contained a percentage of the finer condensable hydrocarbons; and he presumed, in using ammoniacal liquor, they restored to the gas as it came from the mouthpiece that which the gas carried to a point where it was of no further use. As to the loss of ammonia, there was exceedingly little exposure to the ammonia; and what did not go off by evaporation passed into the retort, and therefore was condensed over again. Practically, therefore, the loss must be a very small fraction. Mr. Hepworth's more recent experience was as new to him that morning as it was to the whole meeting; and he was exceedingly obliged to that gentleman for the manner in which he had conducted the experiments for him, and also to Mr. Warner for giving permission to have the arrangement placed in his works. His feeling even as to the most expeditious method of removing obstructions in ascension-pipes was that, if they could find a plan for preventing them, it was preferable to any method of removing them. Some time ago he said to Mr. Hepworth that he marvelled ascension-pipes were not made of steel or wrought iron, because he found, in the work he did in connection with the inlet-pipes under the coke-oven floors, that cast-iron pipes took pitch much more readily, and that when it was on it was knit more closely to the iron than it was to steel. There seemed to be an affinity in nature between pitch and cast iron, which was not the case between pitch and either wrought iron or steel. He was very greatly obliged to the members for the manner in which they had received his paper, and for the criticisms that had been offered.

Mr. W. FORD (Stockton) proposed a vote of thanks to Mr. Armour, who, he said, had come among them as a stranger. It was so long since he had had a stopped ascension-pipe that he had forgotten what it was. He really must differ from his old and esteemed friend Mr. Terrace, who said the water in the hydraulic main was a perfect cure for stoppages. He himself tried it many years ago; and now he was working with a seal of tar in the hydraulic main, and he had no stoppages. He believed that Mr. Armour's cure would not be successful in every case. There was variety in coal, variety in temperature, and variety in the construction of apparatus. Everything must be studied on the spot, if a cure for the evil was to be found. If those gentlemen who converted gas coal into coke were to adopt this little invention of Mr. Armour's, it might be the means of accumulating thousands a year to them. He had had some little experience of the Simon-Carvès process, at a colliery; and if Mr. Armour's inventions could be applied to that process, there would be great benefit to colliery proprietors who worked up their secondary products in that way.

Mr. BOWER seconded the motion, which was unanimously carried.

Mr. ARMOUR briefly acknowledged the vote.

VOTES OF THANKS.

Mr. J. H. COX (Sunderland) proposed a vote of thanks to the President. He was, he said, quite certain that, if gentlemen in similar positions to Mr. Wallis were to do as he had done, it would benefit them all.

Mr. T. TREWHITT (West Hartlepool) seconded the motion, which was passed.

The PRESIDENT having thanked the members for their confidence in him,

A vote of thanks was accorded to the Secretary and Treasurer, on the motion of Mr. WARNER, seconded by the PRESIDENT.

The Association were afterwards entertained to dinner in the Royal Hotel, by the Directors of the South Shields Gas Company. Several members of the South Shields and Jarrow Corporations were also the guests of the Directors. Mr. Wallis again presided, and made a most genial Chairman.

MIDLAND ASSOCIATION.

QUARTERLY MEETING, OCT. 22.

This Meeting was held at the Great Western Hotel, Birmingham. The President (Mr. C. S. Ellery) was unable to attend, owing to business of a pressing nature; and, in his absence, Mr. R. O. PATERSON, of Cheltenham, was voted to the chair.

NEW MEMBERS.

The Committee recommended the election of the following gentlemen as members of the Association: Mr. R. Jones, Manager of the Dawley Gas-Works; Mr. E. Layton, Manager of the Sutton Coldfield Gas-Works; and Mr. W. Murray, Manager of the Uttoxeter Gas-Works. The recommendation was unanimously adopted.

ELECTION OF PRESIDENT AND OFFICERS.

Mr. J. ANNAN (Wolverhampton) proposed that Mr. William Littlewood, of West Bromwich, be elected President of the Association for the ensuing year.

Mr. H. HACK (Saltley, Birmingham) seconded the motion and it was carried unanimously.

Mr. LITTLEWOOD having thanked the members for the compliment they had paid him,

Mr. J. S. REEVES (Bilston) proposed that Mr. P. Simpson, of Rugby, be re-elected Treasurer; and the motion was carried unanimously.

Mr. LITTLEWOOD remarked that they could not have had a better Secretary than Mr. J. S. Reeves; but as he now wished to retire from the office, he (Mr. Littlewood) had pleasure in proposing that Mr. Meiklejohn, of Oldbury, be elected Honorary Secretary.

Mr. W. T. TEW (Warwick) seconded the motion, and it was carried.

Mr. J. S. Cranmer (Stratford-on-Avon), Mr. V. Hughes (Tipton and Mr. J. S. Reeves (Bilston) were elected on the Committee—the two former being in substitution of retiring members, and Mr. Reeves in place of the late Mr. J. Deakes, of Worcester;

and Mr. W. W. Hulse, of Longton, and Mr. J. C. Belton, of Wellington, were appointed Auditors.

THANKS TO THE RETIRING OFFICERS.

The CHAIRMAN proposed a vote of thanks to the President, for his admirable conduct in the chair during the past year. He included in the resolution a similar vote to the Treasurer, Secretary, and Committee; remarking that they had all fulfilled the duties of their respective offices to the entire satisfaction of the members.

Mr. LITTLEWOOD seconded the motion, and it was carried.

THE LATE MR. DEAKES.

The CHAIRMAN said that since their last meeting they had lost one of their most esteemed members in Mr. Josiah Deakes, of Worcester; and they would all agree that it was only right that they should convey to his widow and family their sense of his loss. He moved that the President and Secretary be asked to send a letter of condolence to Mrs. Deakes.

The proposition was agreed to.

Mr. HACK then read the following paper:—

ELLIOTT'S PROCESS OF CONTINUOUS CARBONIZING.

It will be remembered that when the members of this Association visited the Swan Village Gas-Works, on the 13th of November last, to inspect the Elliott process of continuous carbonizing as in operation there, the author was unable to afford any definite information respecting it, but stated that, whether the experiment proved successful or otherwise, the results should be communicated to you. He has now the pleasure of fulfilling that promise.

In July, 1888, the author paid a visit to the Ludlow Gas-Works to see the system at work as applied to a setting of three single retorts, 10 feet long, as described in the *Journal of Gas Lighting* for Nov. 5, 1889. Although from these retorts being worked in conjunction with others, Mr. Elliott was unable to give any statistics by which the results could be compared with those obtained from the ordinary settings, charged and drawn in the usual way, yet, judging from the apparent ease with which the operations were effected, the satisfactory condition of the coke as it fell from the cylinders (of good size, thoroughly carbonized, and requiring no quenching), and the generally favourable account given of the process by Mr. Elliott, the author felt justified in recommending his Committee to sanction a trial upon a slightly extended scale, in conjunction with the experimental plant at the Swan Village Gas-Works, in which the yield of gas as well as residuals could be accurately determined—the only satisfactory way of arriving at a just conclusion of any proposed new method of carbonizing.

Messrs. Cockey and Sons, of Frome, having made the ironwork for the Ludlow setting, the author deemed it prudent to entrust that portion of the work to them, with the view of reaping the benefit of any improvement which the experience at Ludlow might indicate as desirable; and the patentee was instructed to confer with that firm, so that the details might be arranged in accordance with his views, and to suit the conditions of the old beds or archways in which, to save expense, the installation was to be made. The dimensions and form of these would not admit of the *best* arrangement that could be designed for a trial of the system. Greater height and width would have been preferable; but the author deemed that, without building new arches, the value or otherwise of the principle could be tested.

The drawings on the wall show the settings and the general arrangement of the gearing, coal-hopper, gas ascension-pipes, and feed-pipes. [The general arrangement is shown on p. 308.]

The members will recollect that there were two settings, each of five single retorts, 18 inches in diameter at the front or charging end, and 20 inches at the discharging side; the length over all on the horizontal being 10 feet, and 11 ft. 6 in. on the slope, the fall of the bottom of the retort from the front to the back being 20 inches, making an angle of 8° with the horizontal. The increase in the diameter of the retort at the coke cylinder end is given, as will be readily understood, to prevent wedging of the coke; and so, apart from the slope, afford additional facility in the operation of discharging.

A Körting steam-jet exhauster was employed, the dip-pipes being sealed 2¼ inches, and an exhaust of from 18-10ths to 20-10ths maintained in the hydraulic main—the pressure on the retorts, as shown by the gauge, averaging about 4-10ths. The condensing-main, scrubbers, purifiers, and purifying medium being the same as used in connection with experiments upon the same kind of coal distilled in the ordinary retorts in the usual way, for a comparison of results it is unnecessary to describe them in detail.

The author had ascension-pipes and a hydraulic main provided at *both* ends of the settings, so that, in the event of the system proving in other respects a success, a comparison of the results might be made with the gas taken off alternately from either end of the retort, and principally with the idea of ascertaining, on a practical scale in each case, the effect upon the composition and quality of the gas—in the one case the gas from the new (hourly) charge having to pass over coke of a gradually increasing temperature; in the other, just the reverse of these conditions obtaining. Our Continental brethren have frequently asserted to the author that our through retorts, worked with a hydraulic seal, were the chief cause of the trouble with stopped pipes, and the deterioration in the quality of the gas produced; their idea being that, despite all care in adjusting the level of the hydraulic main and the dips to a uniform seal, in course of time variations in the level and contents of the hydraulic main will cause a difference between one side and the other in the resistance offered to the gas, when, however slight this difference may be, the tendency of the gas must be to escape up the pipe where there is the least resistance to be overcome, in which case it passes over (assuming a 20-feet retort) 10 feet average length of heated surface, as compared with 5 feet if each pipe took its due share—the effect being to decompose the gas, the volatile constituents passing off to the main, causing carbon to deposit itself in the pipes on its way there. The author firmly believes in this theory, and would advocate single retorts set end to end, or long retorts blocked in the middle, were it not for the difficulty of removing the rapid accumulation of carbon that takes place at the back end of the retort, and the hindrance to a satisfactory application of machinery for charging and drawing such retorts; for, when newly set, for such as West's machinery, a slight clearance space must be left between the end of the scoop and the end of the retort, while, to allow for a carbon deposit, the scoop must be made still shorter, causing an objectionable gap on the floor of the retort at the hottest point. But few, I think, would now-a-days recommend single retorts, with an external wall at each end, on account of the additional loss of heat by radiation.

But this is a digression which please excuse; and I will now briefly explain the drawings [see next page] and the operations, and afterwards state the results of the first three experiments, as given in the accompanying table.

Before commencing the operation of charging the retorts, both ends of the feed-pipes A are closed by the sliding-plate B, and the throttle-valves D respectively. The broken coal is then tipped into the hopper; and by means of the lever C, the sliding-plate B is moved until the holes in it are concentric with the feed-pipes A. Thereupon the coal falls into the five pipes as far as the throttle-valves D; and the sliding-plate is moved back into

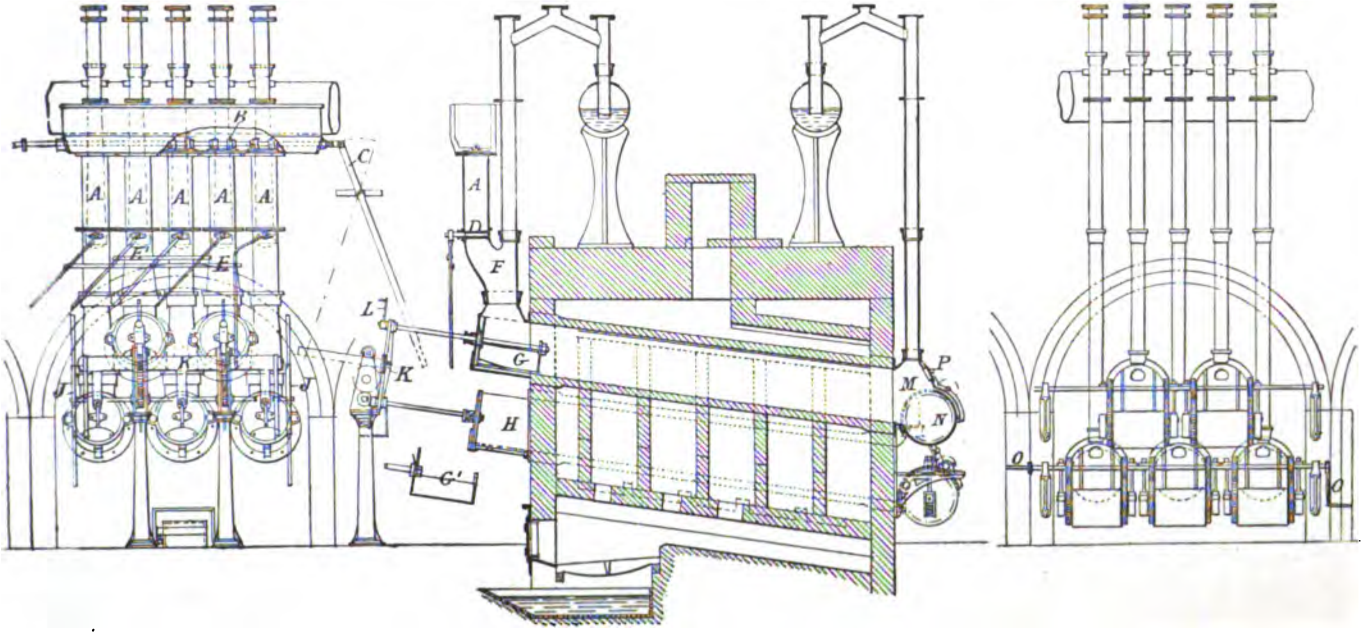

FIG. 3.—GENERAL ARRANGEMENT OF PLANT EMPLOYED IN ELLIOTT'S PROCESS OF CONTINUOUS CARBONIZING.

its original position. Upon working the levers E and E^1, the throttle-valves D are opened; thus allowing the coal to fall through the breeches-pipe F, into the scoop G, which is in position within the mouthpiece H. The levers had to be worked to-and-fro several times, to cause the whole charge to clear the valve, which caused an obstruction when opened to the extent of about one-third of the area of the pipe. After the coal has fallen, the throttle-valves are immediately closed.

The five scoops G (with the coal in them) are now propelled into the retorts by the frame and shafts K, which, in their turn, are actuated by the hand-wheels J. When the scoops have advanced into the retorts the required distance, they are turned over by working the cranks L, depositing the coal on the bottom of the retorts. The scoops are now drawn back into the charging-mouthpieces H, by reversing the motion of the hand-wheels and the frame and racks K, and are then turned into their original positions ready for the next charge. As the scoops advance into the retorts, they are intended to push forward the partly carbonized coal, and the coke in front of them, causing that portion nearest the discharging end to fall through the mouthpieces M into the coke cylinders N. When the coke has cooled down to blackness, or earlier if found more convenient, the cylinders N are rotated by working the cranks or ratchets O connected to the spindles and spur-wheels; the coke falling out of the cylinders into iron barrows or other suitable receptacles. The cylinders are then reversed, ready to receive the coke forced out at the next charge.

With regard to the setting, for convenience in firing and economy in labour, the furnace in the usual way would have been best put at the coke cylinder end, so that the coke required for fuel could have been supplied direct to the furnace. But for the purpose of these trials, and to save the expense of underpinning the existing bench-walls, it was placed at the opposite side; and this undoubtedly is the best position for securing the highest temperature at the point where most required. At the same time the arrangement caused considerable inconvenience to the firemen, through their having to work in a cramped-up position under the gearing, against which they were liable to get a severe knock when withdrawing from the furnace.

As will be noticed from the figures in the table, with the exception of the coke, which was of good size, and fully equal to the usual weight per ton of coal, the results were eminently unsatisfactory, compared with those obtained from the same coal under the ordinary method of working.

Although the slope of the retorts was 50 per cent. greater than those at Ludlow, the principal difficulty encountered in each of these trials, was the continual heaping up of the coke or partially carbonized coal about a yard from the feeding end of the retort, until the area at that point became almost, if not completely choked, when it took more power than the two men could apply to the gearing to even move the obstruction, which had to be got over by using a small rake through the opening in the cylinder cover P, and gradually drawing it down. The idea of the inventor was that the solid end of the scoop, as it entered with the fresh charge, would easily drive the whole mass in front of it forward; but this is precisely what in these trials it failed to do. On the contrary, the previous charge doubled up like india-rubber, taking the form of a camel's back, not possessing the necessary rigidity to advance against the resistance offered by the weight of the material ahead. Notwithstanding the effort made to maintain the feeding end of the setting at as high a temperature as possible, by directing the bulk of the furnace gases to that side, the frequent charges of coal lowered the temperature at that point so much that, at the end of the hour, the previous charge had only been reduced to a soft pitchy condition, void of any sliding propensities whatever. Difficulty was also experienced in keeping the throttle-valves in the feed-pipes gas-tight; for although they were so at the outset, the accumulation of pitchy deposit on the faces soon rendered them more or less leaky—the usual result of valves placed in such a position—so that when the coal feeding took place, a lot of gas was lost through the feed-ports in the hopper, and to a smaller extent it escaped there continually from the same cause when the feed-ports were closed, as those valves also could not be made anything approaching gas-tight. The author thought that the difficulty with the throttle-valves might have been overcome by the introduction of a continuous sliding-plate, as arranged for the hopper, but between two planed faces. On further consideration, however, and after talking the matter over with one who had considerable experience in such work, he concluded that even such an arrangement, although it might perhaps prove an improvement upon the valves, would not work so satisfactorily as to warrant an expenditure in that direction. He, therefore, abandoned the idea. The valves—then top and bottom—were one source of loss as regards gas, and consequently tar and ammoniacal liquor; and another was the escape which took place each time the coke cylinders were emptied. Though the operation of discharging was quickly performed—not taking more than three minutes for the ten mouthpieces per hour—the escape from each cylinder was about 20 seconds per charge, equal to 8 minutes per 24 hours, which, at first thought, appears insignificant. But, on the ordinary plan (hand-charging), the duration of the escape of good gas amounts to about 1¼ minutes per mouthpiece per charge, or a total of but 6 minutes per 24 hours—being 25 per cent. less than this continuous method. But taking into account the loss which also frequently arises upon the opening of the lids when the charge is not thoroughly spent at the end of the period allowed for distillation on the customary plan, the author is of opinion that there cannot be much difference in the two systems under this head.

A third source of loss was during the removal of the augering-lid P to clear the pipes, and to draw the coke forward, which (as shown by the remarks in the tables) was frequently required. Leakage from the glands in the covers at the charging end, through which the scoop-rod was worked, also contributed to the total loss. The author attributes, as a further and perhaps the principal reason, the heaping up of the imperfectly carbonized coal before alluded to (which, forming a block practically the full area of the retort, would leave but little or no passage for the gas on one side of it); a deal of condensation taking place in the closed ascension-pipe, and gas escaping through the pores of the retort under the extra pressure existing at times. When working up the coke cylinder end, the tar from condensation would fall into and around the scoop, and render it in a condition to "stick" to some of the coal at the next charge, instead of delivering it when turned over; its capacity being thus gradually reduced. And there is no doubt that the surface of the cast-iron feed-pipe from the outlet to the valve contributed to the condensation at that end of the setting.

Stopped pipes also played an adverse part; and this nuisance is aggravated in a process requiring the unbolting of cover-plates and augering amidst racks, spindles, &c. But allowing for all these drawbacks, it appears to the author that there is a margin of loss which he has not, and is unable to account for; and he hopes that the discussion which may follow the reading of this paper, may indicate further sources of loss than those he has thought of and touched upon.

Soon after starting, it was found that the circular slide-valves arranged in the coal-hopper, as shown by the drawings, although fitted with clearing-ploughs, would not act efficiently—the continuous shaft and the valve attachments preventing the coal dropping freely into the feed-pipes A. The connections to the shaft also dragged part of the coal to-and-fro as the valves were moved, and also formed a gradually increasing obstruction of coal between the outer valves and the ends of the hopper; so that at times it was impossible to move the valves at all without very great strain. Between the second and third trials, therefore, the author had all these valves removed, and substituted, in lieu thereof, a continuous sliding-plate, having holes cut in it of the same diameter as those over the coal-delivery pipes, worked by the same levers at either end of the hopper, as before. This resulted in an improved feed, although with that arrangement, as well as the former, the coal would wedge and lodge at times in the hopper in the form of an arch, which had to be broken through from the top before another charge could be given. The feed-pipes would also choke at times below the hopper, through the trickling down of tar, the result of condensation of the gas that had escaped through the throttle-valves. This latter inconvenience might, perhaps, have been partly or wholly obviated, had the feed-pipes been made of a larger diameter towards the throttle-valve, instead of being quite straight.

As Mr. Elliott attributed the non-success to the "jamming of the coke against the sides of the coke cylinders," which, through an oversight on the part of the contractors, had been made with openings of somewhat less width in the clear than the retort at the cylinder end, the operations were entirely suspended for a time, and others were ordered from them with a coke-way of equal width to the retorts, and a fresh start was made with these on one bed only on Aug. 25 last; the throttle-valves, sliding-plate in the coal-hoppers, ascension-pipes, and feeding-pipes having been, during the interval, thoroughly cleaned and adjusted, and the retorts overhauled and repointed. In addition, the rod which, in the last experiment, passed through, as well as the sloping-plate in, the scoop, were (at Mr. Elliott's suggestion) removed. These had been an obstacle to its filling evenly; the coal, in falling from the delivery-pipe, being splashed by the spindle over the edges of the scoop, which, together with the sloping-plate, also materially reduced its capacity.

For the greater part of the time occupied by the first three experiments, Mr. Elliott was present, and superintended the operations; while, during these last trials, the author expressly stipulated that he should be present the whole time—every assistance on each occasion being rendered him to overcome the difficulties which arose. In fact *carte blanche* was given him to do whatever he thought desirable to make the experiment

PERIMEHAM) GAS-WORKS,

“ ELLIG.”

Gas.			Remarks.				
r Ton of Coal rbonized.	Average Jet through-out the Trial.	C p n Av Illu t Po	Retorts Blocked with Coke and Coal.	Single Charges Missed.	Times Coal Delivery Pipe Blocked.	Times Scoops Fixed.	Ascension and Arched Pipes Stopped.
bic Feet.		Can					
9,666	0·99	11 up er	10	7	6	..	..
8,393	0·792	16	105	2	..	8	..
7,688	0·94	12 up er	Rake used at cylinder end almost regularly to prevent blocking.	52	..	36	60
10,414	..	16					
8,023	0·755	15 up er	30 (Also the Jet Exhauster was filled with a sooty deposit twice.)	20	..	18	28
8,030	0·727	16 up er	56	56	12	25	5
10,978	..	17					

T

h coke and coal, the]. During all the experiments the temperature of the retorts
possible uniform. ssure on the retorts being from 4-10ths to 4½-10ths.

successful, if possible. Notwithstanding the alterations referred to, there was practically no diminution of the difficulties which arose in the previous attempts, the coal and coke heaping up as before; and, on the whole, having regard to the superior coal used, the results were equally as unsatisfactory. But while this was so, I would draw attention to the fact that, when the gas was taken off at the cylinder end, the number of stopped pipes was much augmented; confirming, in this particular at all events, the view enunciated at an earlier stage of this paper.

Sanguine as Mr. Elliott appeared to be all along as to ultimate success, on the second day of the final trials, he left, admitting the results were still so unsatisfactory that it was useless to proceed any further with the experiments; stating, however, that he was yet confident that the process was right in principle, and that he would ultimately achieve success. While the author has grave doubts upon this point himself, he would say that, from the large amount of time and labour which he knows Mr. Elliott to have bestowed upon the matter, he is deserving of such a reward. (The results of the last trials are also given in the table.)

The capacity of the feed-pipes was arranged for ½-cwt. charges, or 12 cwt. per mouthpiece per diem; this being about 2 cwt. more than the usual charge per mouthpiece for the adjoining ordinary settings (in which the retorts are of the same size). But before the first trial was commenced, Mr. Elliott thought, from his experience of working the apparatus, that ½-cwt. charges were somewhat too heavy for the temperature of the settings, and he suggested a reduction, with a view of overcoming some of the difficulties encountered. This was done by introducing a short length of wrought-iron pipe, 6 inches diameter, within the feed-pipe just under the hopper; but as this alteration did not have the desired effect, the pipe was removed before the second trial was started. On account of the difficulties met with—charges missed, and so on—the actual weight carbonized in the subsequent trials also works out considerably less than the original estimate; varying, as can be deduced from the table, from a minimum of about 7 cwt. to a maximum of 9½ cwt. per mouthpiece per diem. If this large reduction of duty per mouthpiece could not be eventually improved upon, the author is of opinion it would of itself be sufficient to condemn the system.

During all the experiments, the tar and liquor produced in the hydraulic main ran with the gas through the condenser-pipes along the retort-house wall to the inlet of the scrubbers (all the balance of the ammonia not eliminated by the condensed steam from the jet-exhauster, was extracted by the scrubbers), from which point both were conducted, together with the scrubber liquor, into one tank, from which they were pumped into a measuring-tank, and the quantity of each very carefully ascertained at the end of the experiment, after due time had been allowed for the tar to separate from the liquor. While the yield of tar in all cases was absurdly low, the ammoniacal liquor from the nut coal was not much below that usually obtained from the same coal; yet it was very remarkable that, under the Welsh coal experiment, the yield was but about half of the normal production—appearing to the author quite out of proportion to the diminution due to the low yield of gas from the various causes related.

As the labour required in working an experiment upon the scale at Swan Village, would necessarily be much heavier than would be the case for a whole bench of retorts when steam or other motive power would be applied for the operations, no useful comparison can be made under this head. But it may be stated that two men per turn of twelve hours were required to do all the work of filling the hoppers, feeding, emptying coke-cylinders, and wheeling the coke away, &c.; the total time occupied for all the work being about two minutes per retort per charge.

In each experiment, the coal was raised in sacks by a winch, and tipped into the hoppers by the attendants; but if the system had proved, or were to prove successful, for its application on a large scale coal-breakers would be provided, and the hoppers fed by the aid of elevators and conveyors as pourtrayed by Mr. Elliott in the *Journal of Gas Lighting* (Vol. LIV., p. 877). In addition to this arrangement, the acme of perfection as regards economy in labour would be a system of gearing, whereby the coke-cylinders would be made to open simultaneously with the charging operations hourly, or at such intervals as might be found in all respects the most advantageous. Some such plan was devised by Messrs. R. and J. Dempster, of Manchester; but it has, hitherto, the author believes, proved impracticable. Messrs. Dempster's proposals are not very dissimilar to those of Mr. Elliott, except that, instead of a scoop, a piston drives forward the fallen charge. The author understands that an experiment of Mr. Elliott's plan with this modification, and with retorts set at a much greater angle, is about to be tried at the Vauxhall works of the South Metropolitan Gas Company; and through the courtesy of Messrs. C. and W. Walker, of Donnington, who are making the ironwork for it, and by permission of Mr. C. C. Carpenter, the Engineer of the Vauxhall works, he is enabled to submit full particulars of this arrangement for the inspection of the members.

One of the members of the Association, when at the Swan Village works, having expressed to the author that he would expect the gas to contain a larger percentage of carbonic oxide than gas produced in the ordinary way, samples were analyzed; the result being—

	CO.
From ordinary manufacture	8·6 per cent.
„ Elliott's process	10·0 „

Showing no great difference in this particular.

In connection with the trials of this process, the truth of the adages that "history repeats itself," and "there is nothing new under the sun," is again strongly exemplified. Many, if not all of you, are doubtless aware that neither Mr. Elliott nor Messrs. Dempster are the first to propose this system of continuous carbonization, and that it was advocated by Mr. Brunton 50 years ago, and adopted by him singularly enough at the same Swan Village Gas-Works, which is a station of the late Birmingham and Staffordshire Gas Company; he having been at that time their Engineer.

It is a remarkable coincidence that one of Brunton's successors should be, as it were, celebrating the jubilee of the first introduction of such a system, by trying it anew at the same works. Brunton's invention is illustrated and fully described in Clegg (p. 77, 1841 edition).* The author has had the drawings reproduced from that work, and hung upon the walls, that the members may make a comparison between Brunton's and Elliott's arrangements; and it may not be out of place to remind you of the remarkably descriptive letter from Mr. Brunton to Mr. Clegg, jun., respecting his invention. [The author here read the lengthy letter referred to, as it appeared in "Clegg's Treatise."] Brunton's invention is also briefly described in Richards's revised edition of Mr. Hughes's "Treatise on Gas-Works;" the concluding paragraph being: "Mr. Brunton claimed great superiority for this description of retort; and about 1840, it excited considerable attention, was tried in several places, but was not a success."

We have at present at the Swan Village works, an old bricklayer who was engaged with his father in setting these Brunton retorts, and also two of the stokers who worked them, one of whom states that they were first tried in 1837 at Swan Village, and consisted of eight beds of three retorts each—all the work being done by one man and one lad per shift of twelve hours; and after being tried there for a few years, the same patent was applied to some settings at the Adderley Street works, in 1841. There is no record as to the cause of the abandonment of the system of which Brunton speaks so well in his letter to Clegg; but in answer to my inquiries the other day, the bricklayer at Swan Village stated that he always understood it to be due to a dispute about the patent rights, which ended in Brunton being prohibited from continuing their use at both works. The old stoker, however, thinks that the difficulty experienced in selling the saturated coke also contributed to the abolition of the system; but, in the author's opinion, it was more probably due to non-success, or to the general introduction of clay and longer retorts.

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* Brunton's system, here alluded to, was described and illustrated in "King's Treatise on Coal Gas," Vol. I., pp. 179-81.

It will be observed that iron retorts were then used, and that the length was but 4 ft. 6 in.; the bottom sloping at an angle of 7½°. With such short retorts, the difficulty of discharging the coke would probably not arise. It will also be noted that Brunton brought the furnace partly out beyond the face wall of the setting, with the view no doubt of maintaining as high a temperature as practicable at that end of the retort, so that each charge of coal might be fairly well carbonized by the time it had to be pushed ahead—a condition of which he appears to have recognized the necessity, if any degree of success is to accompany any such system of working. It will be noted that he did not use a scoop, but adopted the piston or disc arrangement, as recently proposed by Messrs. Dempster, depending on the piston to push forward the new charge of coal as well as the coke beyond it—a plan which Mr. Elliott now advocates in lieu of the scoop.

Although we may not all agree with Brunton's view as to what takes place in the retort after charging, as expounded in his letter to Mr. Clegg just read, it will be noticed that he lays particular stress upon the fact of his process reducing the quantity of tar liquor, in those days a source of both trouble and nuisance. (What a deal we owe to science for the change that has been brought about since then as regards the value of these residuals!) The results at Swan Village confirm Brunton's experience in this respect; but unfortunately accompanied by a much *smaller* yield of gas, instead of his claim for a large increase. His views as to the effect of forcing the gas over a large body of red-hot coke appear to agree with modern notions upon the subject, although we now try to avoid the "more perfect decomposition" which he aimed at, by *limiting* to as short a period as possible the contact of the gas with highly heated surfaces.

Reverting to the proposals of Mr. Elliott and Messrs. C. and W. Walker for the Vauxhall works, it should be mentioned that, before arranging the detail, Messrs. Walker were invited to avail themselves of our experience at Swan Village; and their representative spent some time watching the operations, with the view of introducing such improvements as, from the difficulties and drawbacks encountered there, might seem desirable. The principal difference is the length of the retort and the angle of inclination; being 20 feet (on the slope) and about 25° respectively—the form of coal-hopper being slightly different, fitted with a continuous sliding-plate on the underside instead of the inside, having much larger feed-ports and slightly larger feed-pipes, and one ascension-pipe only, and this fitted on the charging end. The scoop is abandoned and a piston substituted, so that the charging-mouthpiece stands out but 6 inches from the face of the bed, and the coals drop down a slope in the feed-pipe direct on to the bottom of the retort, more after Brunton's patent; the piston travelling 4 feet at each fresh charge, as against 2 feet at Swan Village. The coke cylinders are 25 inches in diameter by 22 inches wide, compared with 20 inches by 20 inches; the angle of inclination of the discharging-mouthpiece being 15° greater than that of the retort, instead of the same degree as at Swan Village.

An objection to work retorts upon this principle set at a much greater angle—like all arrangements for inclined retorts upon Coze or other similar plans—is the necessity for a stage floor, or travelling stage for charging at a considerable elevation, and the great waste of space above the discharging and below the charging end of the setting. But in the case of gaseous firing upon the regenerator principle, the latter may be more or less profitably utilized for the regenerator. If this great angle, as proposed for the Vauxhall works, be actually necessary for the Elliott principle, I cannot see that anything is to be gained over the Coze or such-like systems. On the contrary, the cumbersome gearing required for the former, whether worked by hand or steam power, as compared with the simplicity of the various arrangements which have recently been devised for charging ordinary inclined retorts, is a drawback which we should all desire to avoid.

Although the author would have felt happier, and better pleased, had he been able to stand before you and show that the process he has tried was one that could be taken up by the profession with advantage, still, as it is admitted that as much as, if not more, is to be learned from failures than from successes, he hopes the particulars given will be of interest, and useful for reference, and may lead to a profitable discussion.

At the close of the paper,

The CHAIRMAN remarked that the members were supposed to leave to visit the Birmingham Oxygen Company's works at Saltley at three o'clock; and as it was then half-past two, there would not be sufficient time to discuss the paper if they were to keep their appointment at the Oxygen works.

Mr. HACK expressed his willingness for the discussion to be adjourned; and said that, under the circumstances, this seemed to be the best course.

Mr. ELLIOTT, on being appealed to, said he hardly thought there was time for a discussion then; and he himself considered it would be better it should be taken at another meeting. He added that he believed the unfavourable results set forth by Mr. Hack in his paper were due to low temperature and excessive leakage. He could not understand the low yield of gas and the small production of tar. He had found the system work well with him at Ludlow.

Mr. CHARLES HUNT (Windsor Street, Birmingham) asked if Mr. Elliott had any particulars of the working at Ludlow—not as regarded the tar and liquor only, but of the yield of gas.

Mr. ELLIOTT said he had not; but he was now working the system there, and he invited anyone to go and see it.

The CHAIRMAN said they all felt—and he was sure Mr. Hack felt it as much as anyone—that there was a certain amount of regret attending the reading of the paper. Their friend Mr. Elliott had been working this particular system for years; and it was difficult to understand why there was such a difference between his results and those obtained at Swan Village by Mr. Hack. He (the Chairman) had lately seen the process of the operation at Ludlow; and Mr. Elliott was evidently getting good working results. But there was obviously too little time that day to go into the question and discuss it thoroughly. He would venture to point out that the effect of discussing the paper then, and closing the matter, would be that the process, which was admittedly a novelty, would be absolutely condemned in the eyes of professional gas engineers. Whether or not the results obtained were to be entirely relied upon, was, of course, open to discussion, because Mr. Hack admitted that he was not able to account for all the working of the process. [Mr. Hack: Not the bad working.] He did not, for instance, account for the weight of coal put into the retorts; and this fact necessarily left the experiment in an unsatisfactory condition in their minds, judging as gas engineers. They must be just to Mr. Elliott. He claimed advantages from this particular process; but he (the Chairman) was not aware that he had fixed himself to results one way or another. What Mr. Elliott said was: "I have invented a system which practically gives you a continuous process of gas making. You take a closed retort. At the one end you draw off the coke, at the other you put in the coal; and at neither of these ends do you take off the lid, or admit air to the retort, as in ordinary gas making." That was an important fact. It might not be a successful adaptation—that he said nothing about—but it was an invention which appeared to give them, from some points of view, considerable advantages; and there might be more in it than they were yet inclined to think. Mr. Elliott maintained that it had advantages; and he (the Chairman) did not think they would be prepared to condemn the process just at present, without looking more fully into it. He did not know that Mr. Elliott had claimed any particular results, and risked his reputation upon them; but the members were risking his reputation upon the acceptance of the paper. He would therefore ask Mr. Hack to allow the discussion to stand over till another meeting. There would, in the meantime, be an opportunity for thinking over the matter, and probably seeing Mr. Elliott's own working of his system at Ludlow. He was sorry to be in the chair, and to have to make these remarks in a *quasi*-judicial character; but he thought it was due to the subject, and also to their friends Mr. Hack and Mr. Elliott.

Mr. C. Hunt said that, after what had fallen from the Chairman, no discussion that day could be entirely satisfactory, either to Mr. Elliott or to Mr. Hack. No one could wish that there should be even the appearance of an injustice to Mr. Elliott; and he suggested that, in the event of the discussion being adjourned, a Committee should be formed to investigate at Ludlow the working of the system, and report thereon to the Association.

Mr. Hack asked if Mr. Elliott was prepared to measure the gas and the residuals; because without this no Committee could form an opinion about it.

Mr. Elliott said the stoppage was causing all Mr. Hack's trouble.

The CHAIRMAN remarked that it would be well not to go into any point then. If Mr. Hunt's suggestion was adopted, was it possible to disconnect the patent retorts from other parts of the works, and enable them to collect the products?

Mr. ELLIOTT said there was no possibility of doing so now; but it could be done in the summer time.

Mr. HUNT said he understood that all the gas supplied at Ludlow was produced by these retorts.

Mr. ELLIOTT: In the summer time.

Mr. HUNT: Then I am afraid the investigation will have to be postponed till the summer.

Mr. HACK: If these retorts have been at work exclusively in the summer time, you would have the figures as to gas, tar, and liquor.

Mr. ELLIOTT: Not as to the tar and liquor.

The CHAIRMAN (to Mr. Elliott): Are you agreeable to the course suggested?

Mr. ELLIOTT: I shall be very pleased to fall in with it.

Mr. HACK: I do not like leaving the results shown by the paper; and I should desire to see if it is possible that success can be achieved by the process. I support the proposition for the adjournment of the discussion of the paper. The suggested Committee might, I think, also go to Swan Village, and there examine the apparatus.

Mr. HUNT then proposed that a Committee be formed, consisting of the Chairman of the meeting (Mr. Paterson) and the President, ex-President, and Mr. Hack, to further consider the subject of Mr. Elliott's retort-charging apparatus, and to report to the next meeting.

Mr. ANNAN seconded the motion, and it was carried.

The members then visited the Birmingham Oxygen Company's works at Saltley, where they were received by Mr. Kenneth Murray and Mr. Andrew Stephenson, as representing the Brin Oxygen Company, and by Mr. T. E. Priestman on behalf of Messrs. R. and J. Dempster, whose work in connection with a two-lift columnless gasholder on the Gadd and Mason principle, with overground tank, attracted considerable attention as part of the oxygen plant, of which the following are particulars: The oxygen apparatus will make 10,000 cubic feet per day. The producer contains 24 cast-iron retorts of 6¼ inches internal, and 8 inches external diameter, set vertically in two bays on either side of a carbonic oxide generator, which supplies the necessary gas for heating the retorts. The quantity of barium oxide contained in the retorts is about 1¼ tons; and the life of the barium in a furnace constantly at work is ckoned at three years. The maximum quality of oxygen obtainable from the furnace which was at work is 97 per cent., and the quality in the holder 94 per cent. The plant is entirely automatic in operation; and the principle of working is well known. The object of the factory in Birmingham is to supply oxygen in a compressed state in cylinders for lantern work, medical, brazing, and other purposes. The compressors for filling the cylinders from the holder are of the ordinary three-staging type, and they compress the oxygen into various sizes of cylinders to a pressure of 120 atmospheres, at which the bulk of gas contained in each cylinder is known, and a measured quantity is in this way delivered to the various consumers. Before being charged, the cylinders are tested under hydraulic power to a pressure of 2 tons on the square inch; and this test is periodically repeated, so as to ensure safety in the delivery and conveyance of gas at this high pressure throughout the country. The inner lift of the Gadd and Mason holder used for storing the oxygen as made, is 38 feet in diameter and 18 ft. 2 in. deep; the outer lift, 40 feet in diameter and 18 feet deep. The steel tank is 42 feet in diameter and 18 ft. 9 in. deep. The bottom of the tank is level with the ground; and when the holder is fully inflated, the height from the ground to the crown is 54 feet—thus fully exposing the holder to the wind. There are six spiral guides at an angle of 45° for each lift, with the guide-rollers and carriages for each guide. The holder has worked without a mishap or a hitch of any kind since it was finished. The first time it was inflated with air, it went up without any difficulty; and it has never been necessary to touch or alter it in any way since.

On their return to Birmingham, the members dined together at the Great Western Hotel.

SOUTHERN ASSOCIATION.

QUARTERLY MEETING, NOV. 12.

This Meeting was held at the Holborn Restaurant—Mr. JOHN METHVEN (the President) in the chair.

The usual routine business first occupied attention.

MINUTES OF LAST MEETING.

The HON. SECRETARY (Mr. J. W. Helps, of Croydon) submitted the minutes of the preceding meeting; and they were confirmed.

ELECTION OF OFFICE-BEARERS.

Mr. C. C. CARPENTER (Vauxhall) proposed that Mr. A. Dougall, of Tunbridge Wells, should be President for the ensuing year.

Mr. J. WEST (Manchester) seconded the motion; and it was carried unanimously.

Mr. DOUGALL having briefly returned thanks,

Mr. H. G. Mitchell (Hornsey) and Mr. C. Gandon (Sydenham) were elected to fill the vacancies on the Committee caused by the retirement of two members by rotation; Mr. J. W. Helps (Croydon) was re-appointed Secretary; and Mr. C. C. Carpenter was retained in his position of Auditor—Mr. W. H. H. Broadberry (Tottenham) being selected as his colleague, in place of Mr. E. Price, resigned.

NEW MEMBERS.

The following gentlemen were then elected members of the Association: Mr. T. N. Ritson, of Jersey; Mr. J. H. Carvosso, of Dartford; and Mr. D. Irving, of Bristol.

Mr. J. TYSOE (East Greenwich) next read the following paper, entitled—

CARBONIZING BY MACHINERY.

Having been asked to read a paper before the members of this Association, and finding no record in the annals of the Society of any treatment of mechanical stoking, I decided to put together a few facts gathered during the course of my experience with the most recent form of stoking machine which is in use at the works under my charge. The subject has recently been most exhaustively dealt with by Mr. West before a kindred Institution; and following him, I cannot hope to impart much that is new. But I know that a great deal of doubt and misconception exists in the minds of many concerning the benefits to be derived from mechanical stoking—fostered to a great extent by the publication of erroneous and misleading reports of deputations, consisting for the most part of gentlemen who have no technical knowledge of the subject which they are supposed to investigate, and who are not careful to note accurately the information supplied to them—and should I succeed in throwing any light on the matter by an account of what is actually being done, this paper will not have been written in vain.

The form of machinery in use at East Greenwich is the latest outcome of the inventive genius of Mr. John West; the power being transmitted by the wire-rope system. I propose to give a short general description only of the machines—the object of this paper being not to describe the details of the apparatus employed so much as to record the results obtained therefrom. The machines, when first erected in 1887, were worked independently, with a boiler and engine on each; and, when fully equipped and in working order, the respective weights were approximately 14 tons for the charger and 10 tons for the drawing machine. These were the first machines constructed on this principle, and will probably be the last. We struggled with them for a time; but it was hopeless. Stoppages would generally occur in the night time, when men could not be readily obtained to continue the work. The whole retort-house work was completely disorganized, and everyone concerned was thoroughly sick of the whole business; and it was decided that engines and boilers travelling up and down a retort-house floor were very much out of place, and that some other motive power must be adopted before we could do anything with the machines. About this time, Mr. West was experimenting with the application of the wire-rope system to his machines; and with such success, that Mr. Frank Livesey, our Chief Engineer, decided to adopt the principle, and arranged with the West's Gas Improvement Company to remove the boilers and engines and erect the machinery necessary for working with wire ropes.

At East Greenwich all the retorts, which are 21 inches by 15½ inches, D shaped, are set in beds of ten in five tiers; and to charge and draw the four top retorts by hand, a travelling stage about 4 feet above the ordinary stage-floor is in use. The conditions are much more adverse to the employment of machinery than in beds of the ordinary height, as the machines have to be

RETORT-HOUSE FITTED WITH WEST'S WIRE-ROPE MACHINERY AT THE EAST GREENWICH GAS-WORKS.

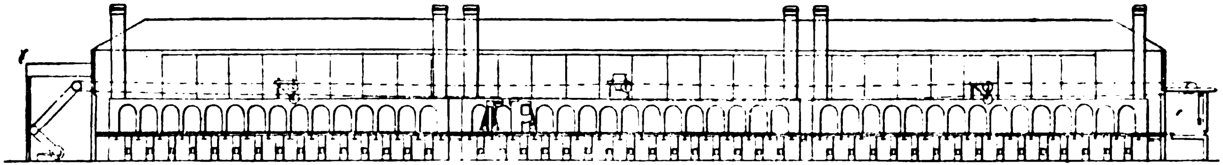

FIG. 4.—LONGITUDINAL ELEVATION.

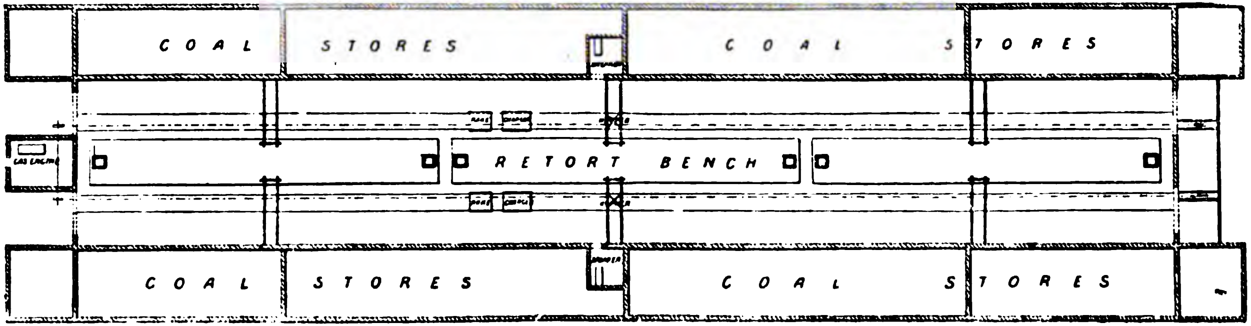

FIG. 5.—PLAN.

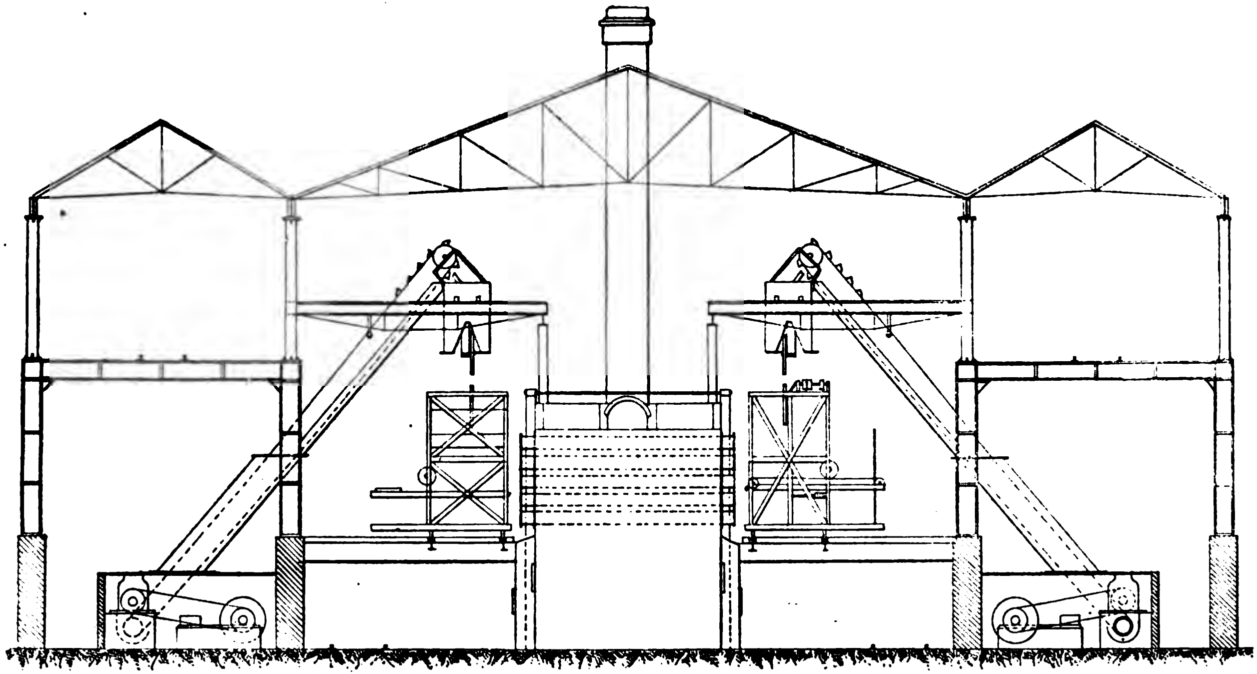

FIG. 6.—CROSS SECTION.

made so much heavier, which means increased initial cost and extra wear and tear. With the first machines, we had no extra travelling-stages to draw and charge the top retorts in the event of a breakdown. So we had to improvise a stage for this purpose, with wooden trestles and planks; and as these were frequently brought into requisition, it will readily be seen that the position was not an enviable one.

The alterations were completed early in the present year; and in March the machines were started, and have been constantly at work up to the present day with eminently satisfactory results. The accompanying illustrations [see figs. 4, 5, and 6] show the general arrangement of the machinery and of the retort-house. The benches are erected in three sections, 15 beds of ten in each section, with a 6-foot passage at the ends. At present machinery is only in use in the middle section of one house; but a further extension is contemplated. The motive power is derived from a 16-horse power "Otto" gas-engine, situated at one end of the house. A belt from this drives a countershaft on the wall, on which run fast and loose pulleys, and from which the main shaft above carrying the rope pulleys is driven. The steel rope, of ⅝ inch diameter, traverses the entire length of the house, and passes round a grooved pulley at the further end, which is fixed to a carriage running on wheels between two girders. This carriage is weighted sufficiently to keep the rope to the required degree of tautness. At three intermediate points, on account of the length of the house, the rope is supported by carriers to keep it at a sufficient height from the floor. The bottom of the rope passes once round a large grooved pulley on each of the machines; and this pulley works the gearing by means of which the various motions are manipulated and controlled.

The power is transmitted to the various movements of the machines by 3½-inch double leather belts; and the situation is a very trying one for belts—in fact, it would be difficult to find a worse one. High speed, pulleys of small diameter, short belts, constant shifting from pulley to pulley in reversing, heat and coal-dust combined, are conditions under which the best belts might well fail. But notwithstanding this, we are not greatly troubled in this respect—probably owing to the frequent examination which the belts receive between the draws. Frequent examination of all parts is absolutely necessary, in order to minimize the risk of a breakdown. It is perhaps not a position to be particularly proud of; but I consider myself somewhat of an authority upon the results of a breakdown during a draw, as with the original machines, with self-contained boilers and engines, my life and the lives of the carbonizing foremen were rendered a misery from this too frequent occurrence. I do not wish it to be understood that we have absolutely no trouble with the present form of machines; but what trouble there is, is confined to the charging-machines and the elevator chains used for carrying coal from the coal-breakers to overhead hoppers which supply the hoppers on the charger. It would be strange, taking into account all the conditions under which they are working, if a hitch did not occur sometimes; but the best material and workmanship having been employed in their construction, it only remains for reasonable care to be bestowed upon the maintenance of the various parts, to ensure practical immunity from stoppages of any kind. Much trouble has been caused in some places by the driving-rope; and I fully expected we should meet with a like experience. But after more than eight months constant work, the rope appears not to have suffered in the least, which speaks volumes for the excellence of the material of which it is made.

The rake is the more simple machine of the two; and there being fewer parts, and the whole affair much lighter than the charger, we have practically no trouble with it. In the hands of a competent driver, six strokes are usually sufficient to discharge a retort; and this process is effected in about 40 seconds. The form of scoop in use with the charger is semi-circular in section, with a plate or midfeather running down the centre longitudinally. The capacity of the scoop is 1¾ cwt. when filled; and it enters the retorts twice at each charge. By means of reversing gear, the scoop is turned over to the right and left alternately; the object being to distribute the charge more evenly along the bottom of the retort.

I am at present experimenting with a scoop of my own design, from which I hope to obtain good results. I was led to the consideration of the subject by the desire to dispense with as much gearing as possible; and the turnover and reversing arrangements of the scoop as supplied to us, although very good in action, are liable to frequent disorder. The scoop I have devised [shown on drawing, fig. 7], is constructed with a sliding bottom plate containing twelve ports 3½ inches wide, with 3½-inch spaces between. Inverted V-shaped pieces corresponding with the ports are fixed across the scoop, and riveted to the sides. When the scoop is filled with coal, the ports are under the V-pieces, and are consequently closed Rods are fixed to the sliding bottom working along a guide-rod, on which, at the required position, a stop is fixed. As the scoop is propelled into the retort, at the position of 3½ inches from the end of the stroke, the rods connected to the sliding bottom catch against the stop; the effect being to hold the bottom in position while the rest of the scoop travels another 3½ inches, when all the ports are opened, and the coal is discharged into the retort instantly. On being withdrawn, a similar stop at the other end closes the scoop ready for another charge of coal. On the front end, projecting below the bottom, a plate is fixed which levels the charge as the scoop is withdrawn. The action is perfect; and the absence of mechanism reduces the risk of stoppage to a minimum. The drawing-machine I consider almost perfection; and in works where charging machines—which necessitate the use of coal breakers and elevators—could not be conveniently employed, or where the outlay would be too great, the use of a drawing-machine alone would be attended with very good results. The work of drawing a retort is more trying to the men than charging; and if charging alone had to be done, they would readily undertake to do double the number of retorts. Thus fewer men would be required; and the work would be done more expeditiously.

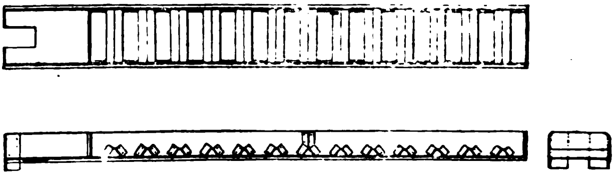

FIG. 7.—TYSOE'S IMPROVED CHARGING-SCOOP: PLAN AND SECTIONAL ELEVATION, SHOWING THE SCOOP OPEN AND CLOSED RESPECTIVELY.

We are about to adopt this arrangement in one of the retort-houses at East Greenwich; and four of Foulis's hydraulic machines, from his latest design, are being constructed for that purpose. When in Glasgow some time ago, I saw these machines at work; and I was much impressed with their performance. Their light weight and absence of complicated parts, place them at a considerable advantage compared with other machines. I am indebted to Mr. Foulis for the drawing [on p. 330] illustrating the machine, which consists of a steel bar of I section marked B, and shown in enlarged cross section at A A, suspended near its centre to a framework of angle-iron marked C. On this bar there slides a carriage D, which is moved backwards and forwards by two hydraulic cylinders, one of which is shown in elevation at E and in cross section at A A. The rake-rod F is attached to this carriage. The bar B, together with its hydraulic cylinders, rake-rod, levers, &c., is raised and lowered (to suit the various heights of the retorts) by means of the hydraulic cylinder G, fixed to the framework C as shown. A rope or chain shown at H, attached to the suspending rope or chain, passes upwards over the pulleys I, and downwards over the pulleys J; the end of this rope or chain being fixed to a frame K. This frame is connected to the rake-bar by a short crank L; and to the same shaft which carries this crank is attached a crank M, which actuates the valve N, for moving the rake backwards and forwards, and also the handle O. The effect of this arrangement is, first, to maintain the rake-bar at the same horizontal level in all positions; and, secondly, it effects the movements for opening the valve, so as to send the rake into the retorts, to depress the back end of the **I** bar, and so elevate the rake that it passes over the coke, the reverse movement depressing the rake and withdrawing it from the retort. On the top of the framework is fixed a joint P, so constructed that the flexible supply pipes may be speedily connected thereto without either screws or bolts. From this joint ½-inch pipes are led to the hydraulic cylinders; the connection being made by means of a flexible tube Q, to admit of the rake being raised or lowered. The whole apparatus is controlled from the platform R. The pipe S is perforated at the front end, so as to discharge some of the water on the rake-rod, and so tend to keep it cool. At the front end of the bar B, is attached a plate T, to prevent the coke from being scattered over the floor. When the bottom retorts are so low that there is not room for this plate when drawing these retorts, it is raised automatically by means of the levers and rods U, actuated by the pulley V, moving between the angle-iron bars W. The machine is moved horizontally from one retort to another by means of the handle X, and the bevel wheels and pinions Y and Z. The quantity of water that is used is small—the cylinders being only 1½ inches in diameter. The time occupied in the drawing of a retort is not more than 35 seconds. At Glasgow, the retorts are set in beds of eight; and the time occupied in drawing the whole bed, including all movements of raising and lowering the rake-bar and moving the machine from one retort to another, is not more than from six to eight minutes.

When the West machines were first started, in order that the men might gradually accustom themselves to working the same,

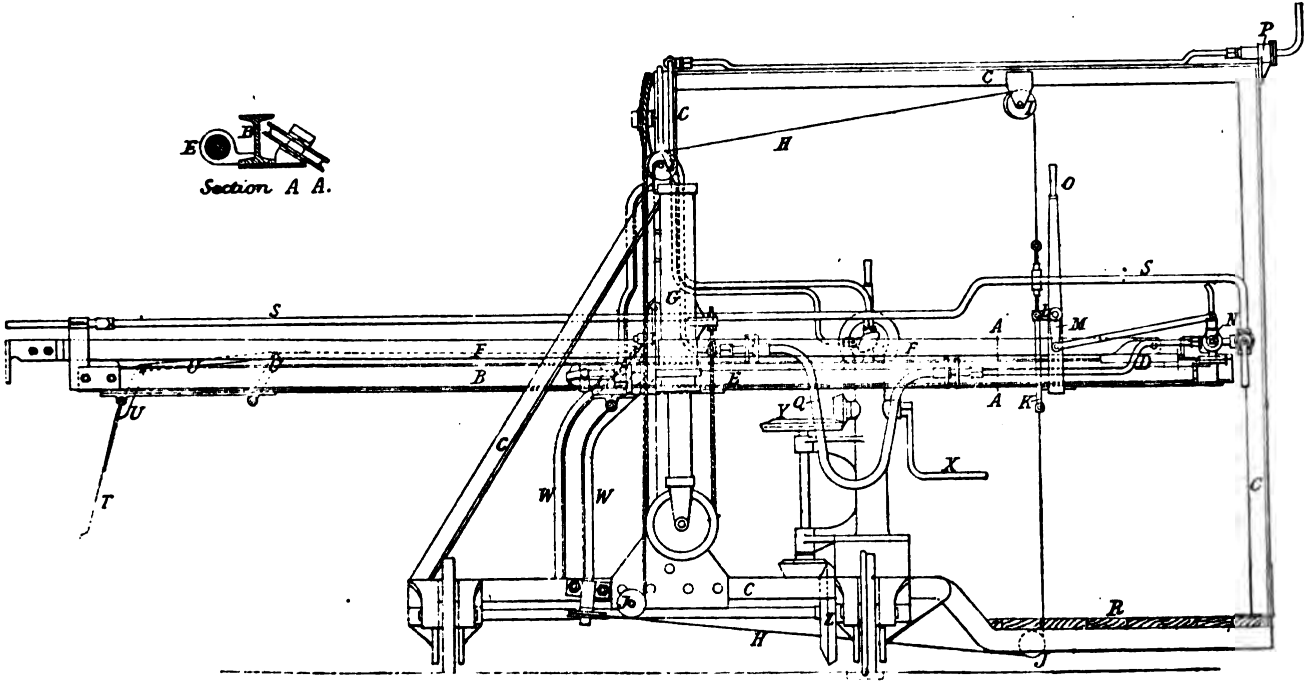

FIG. 8.—FOULIS'S PATENT RETORT-DRAWING MACHIN

only two beds of retorts were operated upon; and this number was gradually increased as the proficiency of the men increased, until the maximum number of fifteen beds was reached, or 150 retorts in all. Six-hour charges are in use, and a draw takes place every two hours; and in order to have a long interval for oiling round and performing any repairs that may become necessary, I have so arranged the work that we have two short draws every twelve hours. Beginning at six in the morning, the two top rows, consisting of 60 retorts, are drawn and charged, occupying one hour. At eight, the next two rows are drawn; and as a portion of coke from these two rows is drawn direct into the furnaces, about fifteen minutes extra is taken. At ten, the bottom row is drawn, and this takes about half-an-hour; thus leaving an interval of 1½ hours before the next draw at twelve. The last draw of the day, at 4 p.m., is also a short one; and the men are enabled to wash and dress and leave the works before five—so that the so-called twelve-hour day is in reality only eleven hours, and six of these are spent in idleness. I may say the same thing applies to the hand work; it is arranged in the same manner.

The coal as delivered from the ship is brought into the stores and deposited directly over the breakers, and is conveyed by elevators into fixed hoppers in the centre of the section, holding about 6 tons each. The hoppers attached to the machines contain about 2 tons 10 cwt.—sufficient to charge fifteen retorts—and have to be refilled from main hoppers when half-way along the row. These main hoppers are two in number, one on each side of the retort-beds; and in the centre of the bench, the elevators which supply them are in combination with the coal-breakers and driven by a 9-horse power "Otto" gas-engine to each. Gas-engines were introduced owing to our boilers being situated a long distance from the retort-houses, necessitating such a length of steam-pipe that would result in considerable loss by condensation. The results of the employment of gas-engines are in every way satisfactory; and the amount of gas required averages 20 feet per ton of coal broken and lifted, and the engines are frequently running when no coal is being lifted. The breaking is not a serious matter with us, as most of our coal is dust before it arrives. The weight of charge per mouthpiece is about 3½ cwt., or 210 tons per 24 hours for the 300 mouthpieces.

The detailed cost for labour of carbonizing, and also cost of maintenance of machinery, is shown by the subjoined tables, which give the number of men required in the 24 hours, their rates of pay, and the cost of labour and material for repairs and maintenance. As I am instituting a comparison between hand and machine work, I am leaving out firemen, coke-wheelers, and those men who are common to the two systems.

MACHINE WORK.

Cost of Labour per Day.

8 machine drivers	at 6s. 9d.	£2	14	0
4 opening doors	at 6s. 0d.	1	4	0
4 shutting doors	at 6s. 0d.	1	4	0
8 furnace fillers	at 5s. 6d.	2	4	0
2 gas-engine drivers	at 6s. 0d.	0	12	0
2 greasers	at 5s. 0d.	0	10	0
28	210 tons at 9·6d. =	£8	8	0

Cost of Maintenance and Repairs per Week.

Oil and waste	£3	0	0
Belts and laces (average)	1	0	0
Gas for gas-engines (cost price)	3	15	0
Wages for repairs	2	10	0
Sundries	1	15	0
1365 tons at 2·1d. =	£12	0	0

Labour . 9·6

11·7d.

In the same number of retorts worked by hand, about 3¼ cw is put in per charge per mouthpiece, equal to 200 tons per day. The cost of carbonizing this is as follows:—

HAND WORK.

Cost of Labour per Day.

12 scoop-drivers	at 6s. 9d.	£4	1	0
24 stokers	at 6s. 6d.	7	16	0
12 trolleymen	at 5s. 6d.	3	6	0
12 furnace fillers	at 5s. 6d.	3	6	0
60	200 tons at 22·15d. =	£18	9	0

Add to this maintenance 0·75

Giving a total cost of . 22·90d.
Against. . 11·70d. for machine work,

Or a saving of. . 11·20d. for every ton of coal carbonized by machinery.

Allowing for the machinery to be out of action for three months every year, for necessary repairs to retorts, &c., a sum of 1½d. per ton would pay 5 per cent. interest on outlay; and this would leave a net saving of 9·7d. per ton. The rate of pay given may seem high, as in fact it is; but when the eight-hour system was introduced no reduction of pay was made—80 retorts being done for 5s. 4d. stokers and 5s. 7d. scoop-drivers.

I was not long in coming to the conclusion that the promised advantages to the Company in the increased efficiency of the men, due to the contemplated elevation of their moral tone, which we were led to believe was the necessary outcome of short hours, was a myth and without any substantial foundation. Instead of an improvement, the reverse was the case; and at the risk of offending our friends of the Gas Stokers' Union, I offered a proportionate increase in wages for 100 retorts to be done per shift on the two-shift system. Plenty of men were forthcoming anxious to earn the extra money, and all the work is now done in two shifts; and I am convinced that it is better for the men and better for the work.

It is well known that, for facility of working machine-stokers, certain rules must be observed as to size and shape of mouthpieces; and another important point that must not be lost sight of in the general arrangements is the position of the mouth of the furnace for automatic feeding with hot coke as drawn from the retorts, and the provision of means for directing it into the furnace. On account of the speed of the rake, and the quantity drawn out at each stroke, this is not so easy of attainment as might appear at first sight—especially with inside producers, as in use at East Greenwich, the coke having to be directed backwards after being pulled forward by the force of the rake.

Different forms of hoppers and shoots were devised; but they either got choked with the fuel, or allowed most of it to fall on to the floor below. At that time we were drawing the retorts in succession, and there appeared to be no practicable solution of the difficulty; as in moving from one retort to another, the position of the shoot had to be altered at each retort, which was difficult of attainment. We then decided to draw the right-hand retorts in each bed first, traversing the row a second time for the left-hand retorts. The question of feeding the furnaces was thus solved, one position of the shoot serving for all the right-hand retorts; and on arriving at the end of the row, the shoot was unhooked and reversed, being then in a position for the left-hand retorts. Two curved plates are riveted to the front of the machine at two different points, one of which is always opposite the furnace mouth whichever retort is being drawn. The moveable shoot is hooked on to the machine just under the retort to be drawn, and the lower end rests upon one of the fixed curved plates. A man standing on the machine with a long rod pushes the coke back into the furnace as it falls on to this plate; and the furnace is thus completely filled. With an outside producer, the operation would be more simple, as the coke would fall directly into it. When the furnace is filled, the mouth is sealed with two shovelfuls of wet breeze rammed hard, and a loose fitting cast-iron cover put over it. This wet breeze soon becomes hard, and hangs in position when the fuel has burnt away from it; and at the end of six hours, when the furnace has to be refilled, it generally requires considerable force to remove it.

The case for machine stoking is not completed with a statement of the amount of reduction in the carbonizing wages. The subject of stopped pipes is always one of interest to gas managers; and a suggestion for the prevention of the evil is always eagerly investigated by those who are troubled with the complaint. The primary cause of stopped pipes is irregular or insufficient charging, together with irregular heating. If the middle of a through retort is at a proper temperature, and a due proportion of the charge is not deposited there, a stopped pipe is the almost inevitable result; or if a smaller charge than the retort is capable of dealing with is put in, a like result may be anticipated. Both these conditions are easy of attainment under the hand system of charging; it being impossible to exercise supervision over each charge, and the men being anxious to get their allotted task over as quickly as possible, it is frequently performed in a slovenly manner.

With the introduction of machinery, an entirely new state of things obtains. It becomes as easy to put in a full charge as a light one, and the driver cannot turn the scoop until it is right home in the retort; and thus a proper charge is guaranteed. The effect of this has been to greatly diminish the number of stopped pipes, and must be placed to the credit of machine stoking. In addition, greater regularity in the illuminating power is maintained—no inconsiderable gain to those of us on whom devolves the duty of meeting the exacting requirements of the guardians of the public with their improved photometers and candles, constantly endeavouring to commit us for a deficiency of one or two decimal points in the value of the light given. Another point is gained by having the retorts open a much shorter time than is usual with hand work, which has an undoubted effect upon the yield of gas. A further saving in the matter of coal-wheelers is effected by means of the elevators, which enable us to dispense with all wheeling on the stage. The figures were not given in the comparison, as the cost varies from time to time according to circumstances. When a ship is being discharged, the coal is dropped direct into the breakers, and at other times it has to be wheeled from the store; but the saving under this head is certainly not less than 1½d. per ton.

Having described the advantages of the employment of mechanical stoking, I may be permitted to point out a possible source of loss that may result. Having it in our power, by the employment of machinery, to greatly increase the amount of coal put into a retort, and being enabled with improved furnaces to increase the heat to the extent required for burning off the charge, it would naturally seem to be an all-round advantage to load the retort to its fullest capacity, as no more wages would be paid to put in 4 cwt. than would be paid for 3 cwt. no extra labour being required for the purpose. But I am of opinion, and my experience confirms it, that there is a limit to the charge beyond which it becomes positively wasteful, although the larger amount may appear to be well carbonized. It is no new thing to hear of a decreased make per ton following upon the introduction of machinery; or a deficiency in the coal when the stock is worked out where the coal is not weighed into the retorts. I would suggest that this arises from the fact that, with a thick layer of coal in a retort, the conditions for efficient carbonization are absent; and although the charge may appear to be thoroughly burnt off, it is open to question whether the same amount of permanent gas is produced per ton as would be evolved by a thinner layer with a lower heat. Acting on this idea, I some time since reduced the charge and lowered the heats, and am confident that a larger make per ton resulted. Smaller charges of shorter duration would probably be better; but there are practical difficulties in the way. Another source of loss appears to me to exist by reason of the necessity for more frequent scurfing of the retorts when machinery is employed. A very small amount of carbon is sufficient to impede the entrance of the rakes and scoops, which are larger than those used in hand work; and the process of scurfing, however carefully it may be performed, is injurious to the retorts besides necessitating their remaining out of action during the time, and causing a leakage after the operation till they have again become scurfed over.

Any paper on the subject of mechanical stoking would be incomplete without a reference to its bearing upon the labour question. In the present state of affairs, anything that tends to minimize the effect of a combination amongst workmen for the attainment of certain objects, regardless of the results to their employers, which is the form usually taken by these outbursts, is worthy of the fullest consideration; and my own feeling is that a justification for the employment of machines, even if no economy could be shown, would be found in the fact that the prevailing disposition on the part of the men would be held in check. It would, perhaps, be difficult to convince the average working man that the introduction of machinery whereby fewer men are required is no menace to him; but I think it can be clearly shown that such is the case. If by improved methods of working, gas can be produced at a less cost, it follows that a lower price will be charged for it; and if previous experience is worth anything, this means that more gas will be used, necessitating an extension of plant and the employment of additional hands in every department of the works. In view of the undoubted economy that can be effected, those who wish to move with the times cannot ignore the claims of machinery for performing the most important of the operations of a gas-works.

Discussion.

Mr. John West (Manchester) said there were a few figures in Mr. Tysoe's paper to which he should like to call attention. Mr. Tysoe had laid before the members the cost of machinery in comparison with hand labour; and he showed that the figure was £8 8s. by the machine working on fifteen settings of retorts, or rather 300 mouthpieces, and by hand £18 9s. With hand work, he carbonized 200 tons per day; and with the machinery, 210 tons. Then he said he had only taken those men who were absolutely connected with the machinery—those who worked on the stage. He (Mr. West) thought that Mr. Tysoe's own figures went to show that the men below had something to do with the matter. There were an additional 10 tons of coal carbonized by the machine than by hand labour; but he was not aware whether Mr. Tysoe paid his firemen and cokemen any less on the 210 tons than on the 200 tons. The most accurate way of giving statistics of this kind was to take all the men working on the old system before machinery was adopted, and after the machinery had been introduced. Mr. Tysoe made the cost of working by hand 22·15d. per ton, and by machinery 9·6d. per ton. If he (Mr. West) was correct in taking the firemen and also the cokemen into the calculation, he made the cost by machinery 13·97d. per ton, and by hand work 28·17d. Adopting Mr. Tysoe's figures, the saving in working by machinery on the total quantity of coal carbonized was £10 1s.; whereas by his (Mr. West's) method of calculation it was £11 5s. There was, however, a much more important matter than that. Mr. Tysoe had been working the machinery on fifteen beds, or 300 retorts; and he told them that it was capable of doing more work, and that more would eventually be done by it. At present these machines were only doing 75 per cent. of the work they were able to do, or that had been done by them in other places. At Beckton, working on the twelve-hour system, the number of retorts charged per pair of machines was 360 per day; and at Manchester, from 360 to 420. At the Whitwood Chemical Works, they were drawing and charging, with 12-hour shifts, from 375 to 390 retorts. He calculated that Mr. Tysoe's pair of machines would be fully capable of working eighteen beds, which would make the same number of retorts as at Beckton. The men that Mr. Tysoe had down in his paper for working the fifteen beds would be employed for the eighteen beds —in fact, there were two more men there than were found to be working at other places. This probably arose from the retorts being five tiers in height. If they adopted Mr. Tysoe's way of reckoning, and only took the men on the stage, the eighteen beds of retorts would bring up the total amount of coal to 252 tons, to 240 tons by hand. They would find this would make a great deal of difference indeed. For instance, with the £8 8s., he would be able to carbonize 252 tons, which would reduce the cost to 8d. per ton, instead of 9·6d. At present the hand work on fifteen beds cost £23 9s. 6d. To this Mr. Tysoe would have to add one-fifth for the three extra beds, which would make the cost £28 3s. 4d., and would carbonize 240 tons of coal; while the cost of machinery would be the same, and yet more coal would be carbonized. If they took all the men, which he contended was the best plan, it would cost by machinery, with the firemen and cokemen, £12 4s. 6d. for the 252 tons, which would be 11·64d. per ton. But if they added one-fifth to Mr. Tysoe's amount for carbonizing the 240 tons, it would come to 28·16d. per ton, which gave a difference (a saving) of 16·52d. The cost for hand work would be 28·16d. per ton; and adding to that ·75d. for wear and tear, it would bring the total cost of the hand labour to 28·91d. To the 11·64d. it would be necessary to add the interest and the wear and tear charges to the other expenses which Mr. Tysoe had enumerated, which amounted to 3·6d. This brought the saving by machinery to 13·67d. per ton. They must add 1½d. for the coal breaking and conveying; and this would make the total saving (say) 1s. 3d. per ton, which he thought was a fair figure. Mr. Tysoe had also told them that there was an increased make per ton of coal carbonized when machinery was employed. This was the universal experience. It was found that the machinery distributed the coal in the retorts more evenly; and by this means a larger volume of gas per ton of coal carbonized was obtained. Besides this, there was a reduction in the number of stopped ascension-pipes; and he wished to point out that something should be taken into consideration for these advantages. It was not a small matter, with a bench of eighteen beds, or 330 retorts, to be able to make 750,000 cubic feet more gas per week than by hand power; and this was how it worked out according to Mr. Tysoe's showing. Another advantage was that, where they worked on Sundays, the number of men required was reduced. He thought that if they put all these advantages together, the saving by machinery at the East Greenwich works would amount to about 1s. 6d. per ton. There was another question. It was necessary to take into account that, where regenerator furnaces were in operation, there was no reason why they should not go on working continuously, until the furnaces or something else gave way. These machines had been at work now for eight months at East Greenwich; and they would go on for three or four months longer without stopping—indeed, he had worked machinery for more than eighteen months. He might add that the machines Mr. Tysoe had described, which only worked at present one-third of the retort-house, were capable of dealing with from 65,000 to 85,000 tons of coal per annum. Now if they simply took the gain at 1s. per ton, it would not be a small matter. It was possible, in fact, to work the machinery to such an extent that it could be almost paid for in one year.

Mr. T. May (Richmond) remarked that at his works they had West's hand-power machines in use; and they found them of great benefit. He might say that his experience was that, with these hand-machines, there was a saving certainly, after allowing for interest and wear and tear, of 10d. per ton of coals. In addition to this, Mr. Tysoe had mentioned other advantages; and there was no doubt there was a reduction of stopped pipes, and an increased make of gas per ton of coal. At Richmond, they easily made 11,000 cubic feet of gas per ton, working with coal which, in many other works, did not very often yield so much by 1000 feet. This was a point which he thought should be made more of in estimating the value of these machines.

Mr. W. A. Valon (Ramsgate) said he could also personally speak as to the benefit derived by the use of West's hand-power machines. They had them at Ramsgate; and they were perhaps one of the first in England to adopt them. They had

had the machines in use a great number of years, with consistent results; the saving having been from 1s. 1d. to 1s. 3d. per ton throughout the whole time. The wear and tear of the machines was very low; and he need not say that the amount of skill necessary to work them was exceedingly small. He was glad to find that the question of machinery was coming to the front so rapidly as it was. He was quite sure it was a move in the right direction. They ought to have gone into it with more courage and determination a good many years ago; and they might then have had some answer to the agitation they had had to meet—in some instances of a very embarrassing character. He had in past years often spoken to engineers on the subject of stoking-machines, and in many cases they had said: "We can do the work by hand labour as cheaply as by machinery, and therefore we do not see the advantage of going to the outlay." He could not convince them that the outlay for machinery would be covered, and the same results obtained; their only reply being that they could not get better results with machinery than they already obtained. He did not think that this was any answer to the question now; for they all saw the importance of having something more to fall back upon than the bone and muscle of the old days.

Mr. CHARLES GANDON (Lower Sydenham) said they had in use, in one of the retort-houses at his works, Mr. West's compressed-air machinery; and, so far, they had found it work very satisfactorily. As to the financial aspect of the question, he could not speak so enthusiastically as Mr. West had just done. There was no doubt it required less stokers than under the old system; but when they came to count up the number of hands they had about looking after the machinery and so forth, the economy in his case in the amount of labour did not come out nearly so large as others had experienced. This was perhaps partly their own fault, because they had a stage house, and the coke was drawn out of the retorts on to the stage, and this interfered with the action of the machinery. He was now trying an arrangement to take the coke away by means of a conveyor and elevator; and if this was successful, he had no doubt they would find the machinery work very much better than at present. When they first used the machines, they found considerable difficulty with them on account of breakdowns. These accidents always happened at the worst time—in the middle of the night, or when they were very busy—and this caused them great inconvenience. Since then, however, Mr. West had made some slight alterations; and he must say that they now experienced very little trouble. He agreed with Mr. Valon that, apart from the question of economy, it was very desirable that they should turn their attention to the introduction of machinery, with the object, if possible, of rendering themselves less dependent upon manual labour.

Mr. **Frank Livesey** (London) said that Mr. Tysoe had dealt so fully with this subject of stoking-machines, that he had very little to say. He might mention, however, that when Mr. Tysoe was working entirely with machinery, the carbonizing wages were very satisfactory indeed; but they were not so now. He meant by this that the results showed better when the whole of the work was done by machines than it did now with only one-third of it. As Mr. West was present, he should like to say that the machine was a very heavy one; but this was probably due to the fact that it had to reach five retorts set one above the other, instead of only three, which entailed having a heavy framework and large foundations. He thought that, if Mr. West turned his attention to this point, he might be able to make a lighter machine, and then possibly a cheaper one. If they looked at the drawing of Mr. Foulis's machine, they would see it had not such a heavy framework. It was exceedingly light, was well constructed, and everything was put in its proper place; but, of course, Mr. West's was a self-propelling machine, and therefore must necessarily carry more gearing.

Mr. **Robert Morton** (London) said he wished to draw attention to a portion of the paper which had not been referred to in the discussion—that was, with reference to the new scoop which Mr. Tysoe had described. There was no doubt at all that a great amount of gearing was required in turning the scoop of Mr. West's machine first to the one side and then to the other; but he did not know that there was very much against it. When at work, too, the noise made by that part of the machine was, in his opinion, almost more than that of all the other parts put together; and there must consequently be a considerable amount of wear and tear upon it. The scoop that Mr. Tysoe had devised seemed to be of very simple construction; and he was satisfied that it would work satisfactorily. If he understood rightly, the scoop had to go into the retort twice; but it did away with those two motions—going first to the one side, and then to the other.

Mr. **Tysoe**: The scoop has to go into the retort twice.

Mr. **Morton** remarked that he did not know there was any necessity for it to go in twice. It appeared to him that Mr. Tysoe might be able to make one large enough to complete the charge in one operation. The means of actuating the bottom were automatic, and did not entail any amount of skill on the part of the driver—it was a purely mechanical thing.

Mr. W. D. CHILD (Romford) said he should like to obtain a little information on one point. He believed that Mr. Tysoe stated that, with the machine-stokers, the retorts required scurfing more often than when charged by hand labour. He had been under the impression that the use of the machines to some extent did away with this—that there was a sort of scraping action of the charger which kept the retort practically clear of carbon as the work went on.

Mr. WEST remarked that the working of the rake and the scoop did keep the retort nearly free from carbon. As to Mr. Tysoe's scoop, it appeared that his ideas had fallen in the same direction as his (the speaker's) had done many years ago. He had the same kind of scoop at work at Richmond and elsewhere ten or twelve years since. It was a very simple thing; but it was not successful, as he could not get the coal up to the sides of the retorts or in sufficient quantities.

The PRESIDENT said he must congratulate the members on the interesting discussion they had had, and also Mr. Tysoe upon having been able to place before the members such an instructive and useful paper. In connection with this subject, he said there was one feature which should be borne in mind. Mr. West had pointed out to them the necessity, before these machines were introduced into a retort-house, of seeing that they had the house of sufficient length to develop fully the power of the machine. He took it that it was not every gas manager who had facilities for placing machines of the kind referred to by the author in a retort-house where their power would be developed to the extent it ought to be. Mr. Gandon appeared to labour under this difficulty with his installation.

Mr. GANDON: Our machinery is fully occupied.

The PRESIDENT said he was not aware of that; but it was very different in the case of Mr. Tysoe at East Greenwich. The machines there could be employed for a greater number of beds; but whether or not Mr. Tysoe had these at his command, he did not know. However, it substantiated the fact that, unless these machines were placed before a sufficient amount of work, the benefit from their use would be materially marred. He might say that the other day he made inquiries as to the behaviour of the machines which Mr. West had erected at Beckton; and he was pleased to report that they were working in a very satisfactory manner. He must express his surprise that it should be thought that, by the use of stoking-machines, the formation of carbon in the retorts was greater than in those charged by hand labour. His experience during a considerable number of years of active work in the retort-house had been that, if there was a large formation of carbon in the retorts, the primary cause of it was due to thin charges of coal. The scoops of stoking-machines were designed to hold a certain quantity of coal, which would fill up the retorts; and if they were properly filled, there was a less amount of scurfing required in them than in the case of those improperly charged. He thought that there was one thing in the paper which had been quite overlooked—he referred to the wear and tear of the machine. Mr. Tysoe had given them some figures which represented the weekly amount expended for oil and tallow and repairs. The repairs, he saw, were put down at something like £2 a week; but probably that represented the attendance of one man. When they paid a stoker for a day's work, they gave him so much money; and this covered all the wear and tear of the stoker. He might work for thirty or forty years; but that had nothing to do with them. In his opinion, there was not sufficient put down in the paper for the wear and tear of the machines. No one could doubt that the durability of a machine, working in the dust and the clouds of steam in a retort-house, was limited; and some consideration ought to be given to that. He wished to lay particular emphasis on this matter, because it was, to his mind, of vital importance. They had a competitor to the schemes of mechanical stoking in the system of inclined retorts. He recently had the pleasure of witnessing at work at Brentford some of the latest adaptations of Mr. Morris's ingenious mind. He had succeeded in charging, with a comparatively small amount of machinery, retorts fixed at an angle of 32°; and he (the President) might say that the charging and drawing of those retorts impressed him very favourably indeed. It was only necessary for him to say that, if it was possible to charge retorts satisfactorily by gravitation (he would not admit that it was done, but he would admit, after what he saw at Brentford, that it was possible for it to be done), then what was the use of introducing stoking machinery at all? There was another point he wished to refer to. It had been stated that the use of these machines was economical in the matter of the coal supply on the stage. He thought there was some little mistake about this. In works where they had an overhead railway, the coals were tipped or shot out of the waggons, and deposited on the stage within easy reach of the stokers. But with machinery, it was necessary to have fixed coal-breakers, which was an additional charge; and, having to put the coal into a breaker and elevator, could not be called an advantage over the old system. As to the introduction of machinery generally, those managers who had charge of works of any magnitude must realize the fact that it would be an advantage to the working man if his arduous labour was superseded by machinery; and in smaller works undoubtedly there would be a great saving by the use of manual machines.

Mr. TYSOE, in reply, said that Mr. West in his remarks criticized his system of making the comparison of cost. Perhaps Mr. West's was the better way; but it simply meant an extra 10 tons of coal per day, which would be a saving, together with the coke. He quite agreed with Mr. West that they could do more work with the machines, and they meant to do more, but they were not at present in a position to do it. They had other beds of retorts at the side of the section that was being worked by the machines. But unfortunately the retorts were much smaller in diameter; and they could not get the scoops in without danger to them and the machinery. He was proposing, however, to put on three more beds, which, he hoped, would make the amount of saving considerably more. Mr. West had also spoken about his (Mr. Tysoe's) scoop. When he made an application for a patent for this scoop, he was told it had been patened by Mr. West something like 17 years ago—in fact, it was described in almost identical words to those which he had intended to use. There was one difference. Mr. West's scoop was only half the length of this one. In Mr. West's original machine, he had a carrier or charger run first into the back end of the retort. Then he withdrew it, and ran it into the front end; and this arrangement was applied to the charger. As to Mr. Livesey's remarks, he had no doubt that Mr. West would be able to reduce the weight of the machines. There seemed to have been a little misapprehension with regard to his observation as to scurfing. What he said was this, that it was necessary to remove the carbon more frequently when machines were employed, and for this reason: That, unless the retort was kept exceedingly clear of carbon, they ran the risk of jamming the scoop in the retort. With regard to the question of wear and tear, he presumed that the President meant that nothing was set down in the paper for depreciation. This was a point he did not deal with; and it would, of course, to some extent modify his figures. He might say that, if he had been the inventor of a machine, he would possibly have made the figures show a larger saving; but as he was not, he preferred to be well within the margin, as some day he might be called upon to substantiate them. The President had also said something about sloping retorts doing away with machinery; but, as far as he could see, there was as much machinery used with them as with ordinary retorts. In conclusion, he ventured to hope that his paper and the discussion would result in the extended use of machines in retort-houses.

On the motion of the PRESIDENT, seconded by Mr. W. E. PRICE (Hampton Wick), a vote of thanks was passed to Mr. Tysoe for his paper.

Mr. R. HERRING (Dover) then read a paper, entitled—

A RAPID METHOD FOR INCREASING THE YIELD OF GAS FROM ORDINARY RETORT-SETTINGS.

Of late years, numerous mechanical aids have been designed for cheapening the production of illuminating gas; but the majority of these are minus two important essentials—viz., reliability and simplicity. Some of the systems, also, necessitate such expensive structural alterations as to retard their general adoption. Therefore, if there is any economical and reliable method of improving results *without* structural alterations being made, more will be found willing to utilize it, in preference to the complicated and costly ones recently introduced.

With this end in view, I have been working for nearly twelve months; and after numerous tests (experimentally and practically), I have ascertained that, with the addition of oil compressed and finely sprayed into the retorts (as will be described) more gas is produced than can be obtained from coal alone. In addition to this increase, other advantages are derived, to which your attention will be directed presently.

Before entering into details or describing the apparatus, a few facts relating to my early experience with mixed charges of coal and oil, will account for my later proceedings. About two years ago, I commenced experimenting with these mixed charges; but I was at the time unacquainted with any method by which oils could be economically and successfully used in the retort-house, either as a mixed charge or as a substitute for cannel coal. The following fact will show how the subject was brought under my notice. When appointed to the management of the Dover Gas-Works, I found a considerable quantity of crude naphtha in stock, which had been accumulating for years; and as tar was frequently boiled for asphalte, &c., the quantity increased. Being unable to sell it, I decided to use some in the retort-house, and commenced as follows: Having procured a sound iron barrow, it was partially filled with small and dusty coal, to which naphtha was added until the whole mass was thoroughly saturated. This mixture was used in various ways for fixed periods; and from close personal observation, I ascertained that when a small quantity was thrown to the middle of the retort just before the charge of coal went in, it gave the best results, which far exceeded my expectations. After a few weeks working thus, the remaining naphtha was substituted for cannel coal. Afterwards, tar-oil and various grades of paraffins were used in the same way as enrichers. This method was worked for about six months. The specific gravity of naphtha was ·980.

During this time, experiments with oils under pressure were carried on; and the improved results from this were at once apparent, convincing me that when this system was perfected, it would be successful. Practical working has since proved this. The oils were compressed to a pressure of 25 to 30 lbs. per square inch; and, by means of the injector, sprayed over the charge of coal or coke, with the retort-lid shut. But before this could be tested in the retort-house, a suitable apparatus was required. Therefore, with as little delay as possible, a machine was constructed on the works, at the commencement of the present year, and is still working.

I now discontinued mixing oil with the coal, and proceeded as follows: (1) Ascertained the pressure that would be required to spray oil into the centre of the settings. (2) Selected any retorts that had been working for five hours (previously charged with coal in the ordinary way). (3) Sprayed the oil over the hot coke, and continued at short intervals for six consecutive hours. Coal alone 5 hours; coal and oil, 6 hours—total 11 hours. The remaining hour is allowed to complete carbonization. The charge is then withdrawn, and the retort recharged with coal only.

Adopting this method, coal was continuously used for eighteen hours, and oil six. The number of retorts thus worked, and the quantity of oil used, depend entirely upon the enrichment required. Spraying compressed oil over the charges with the retort-lid shut, obtain much better results than when the oil is "mixed" with the coal and then put into the retort with either scoop or shovel.

With slight modifications, this system was regularly worked for about three months; but owing to the decreased production of coke, I was compelled to make further alterations, which resulted in the method now in use at the Dover Gas-Works—viz., spraying compressed oil on a full charge of coal. The make of gas is increased and enriched; and the maximum quantity of coke is produced. This result is obtained thus: Select retorts, charged with the usual weight of coal in the ordinary way. Allow this to remain 2 hours, then spray compressed oil over it. Repeat this spraying at short intervals for 3½ hours. The remaining half hour, no oil to be used. At the end of the sixth hour, withdraw the charge, and repeat the operation. From this, you will observe the 24 hours are made up as follows: Mixed charge of coal and oil, 14 hours; coal only, 8 hours; 2 hours to complete carbonization—half hour to each charge. *Example.*—In the retort-house, each gallon of oil yields 85 to 90 cubic feet. I will now show how an increase of 5 per cent. in quantity is obtained on an estimated make of 10,500 cubic feet per ton. The oil required will be 6 gallons per ton of coal used, in equal proportions in each draw. This, at 87½ cubic feet per gallon, will produce 525 cubic feet, or 5 per cent. Should a rapid increase be required (say, during the greatest consumption, &c.), supply more oil in the same way—from 5 to 7 gallons an hour can be safely dealt with.

We will now direct our attention to some of the advantages connected with this mode of working. Gas can be enriched more economically and rapidly than with cannel coal at its present price; and as this enriching can be carried on till within half-an-hour of shutting down, it is very useful at Sunday or other stoppages, as the necessary illuminating power can be maintained to the end. By spraying compressed oil over the charge with the retort-lid shut, more gas can be produced than from coal alone, thus increasing the carbonizing power of ordinary retorts. The maximum quantity of best coke is produced. The make of gas can be instantly increased, thereby benefiting any who are compelled to work with limited storeage.

The machine now working at Dover consists of a small reservoir, to which is attached a force pump. The delivery-pipe is fitted with a pressure-gauge, and communicating with a vessel in which the oil is compressed. To this is attached one or more flexible hose-pipes, long enough to reach over one bed of retorts, and terminating in the sprayer. The whole is mounted on a light carriage. In addition to this apparatus, ordinary ½-inch iron cocks are fitted to the retort lids, and in such a position as to permit of the oil passing clear over the charge, upon which it will fall in the form of spray. If single retorts be used, the oil should strike the back; if throughs, it should just pass the centre; and in no case ought it to fall nearer than 5 feet from the mouthpiece. With this machine, 55 gallons of oil per hour can be sprayed; and this, working nine hours per day, will produce about 43,000 cubic feet of gas.

From these details, you will observe that the special appliances required for this process are few and inexpensive; and also that during nine months use I have found them reliable and easily worked. Up to the present time, low pressure has been used—about 25 to 30 lbs. per square inch; but in future we shall use high compression, by which the expansion after passing the sprayer will be considerably increased, and the oil more thoroughly broken up. On no account should oil be forced into retorts in a solid stream, however fine—minute particles give the best results.

In this paper, my experiences are very briefly stated, respecting practical working with mixed charges of coal and oil, as compared with compressed oil finely sprayed into the retorts, in addition to the usual quantity of coal, by which means an increased yield of gas is rapidly obtained from ordinary retort-settings.

Discussion.

Mr. C. C. Carpenter said he was sure they were all much obliged to Mr. Herring for his paper. There were one or two points upon which it might have been clearer, and upon which he might have given them some information. Not having had a copy of the paper, he (Mr. Carpenter) was not sure whether the results had been obtained by the use of naphtha or some other oil; and he would like to know what was the kind employed. The other point, which was an all-important one, was this: How much gas did he make in the usual way with the ordinary coal; and what was the illuminating power of the gas? Then, what did he consider the proper quantity of oil to use; and what was the increase in the volume of the gas, and in its illuminating power? With regard to the rapidly-increasing yield from ordinary coal, it was not difficult to obtain that with any gas-heated furnace. With such a furnace one could very quickly increase the make per ton by 10 per cent. Then, with the means of enriching gas now in vogue in London (he referred to Mr. Frank Clark's process, in which oil was used), they could very readily raise the illuminating power to the required standard. This was another and a simple way of obtaining results similar to those realized by Mr. Herring.

Mr. T. May asked whether Mr. Herring had worked out the cost per candle of enriching the gas by the process he had described. In a paper which Mr. Frank Livesey read before the Association last year upon the Clark system, he gave the cost of raising by 1 candle the illuminating power of any ordinary quality of gas; and if Mr. Herring could give similar information, it would answer Mr. Carpenter's question and his own.

Mr. A. F. **Browne** (Rotherhithe) said his experience with regard to the injection of oil into retorts had not been very great. He certainly had made some experiments in this direction. Whether it was that he did not try the process on a sufficiently large scale, or whether there was something radically wrong in the system he adopted in getting the oil into the retort, he did not know; but he could not say it was very successful. He injected a large amount of oil into the retorts. He increased the quantity put into each separate retort, and multiplied the number of retorts very considerably; but he was bound to say that, with regard to the increase in illuminating power, on the whole he was unable to get anything like a satisfactory result at all. At the Carshalton Gas-Works, Mr. Good employed for enriching purposes Russian refined oil of ·825 specific gravity. This was, of course, a cheap oil—much cheaper than the oil used in London, in Mr. Clark's process. It would be very advantageous if they could get the good results which were evidently to be obtained with this cheap oil—Mr. Herring obtained them, so did Mr. Good—but his (Mr. Browne's) experience with it was not a success. He next tried some experiments upon the direct carbonization of oil in separate retorts; and in this direction, he had certainly achieved much greater success. He might say that at the Rotherhithe Gas-Works, the only difficulty was that the number of retorts was insufficient, in consideration of the heavy winter make of gas, to affect the whole bulk of gas to any extent. He was now using this system day by day. In the employment of the Russian refined oil, he thought they had a means of enriching gas which would compare favourably in point of cost with cannel, and also with Mr. Clark's process. The direct manufacture of oil gas, of course, took a certain amount of time; but the injection of the vapourized petroleum into the gas direct could be set in full operation in about five minutes. He could not agree that Mr. Clark's process was so cheap as had been stated. He did not wish to say at the present time what was the cost per candle; but he believed the cost of enriching gas 1 candle—from 16 to 17 candles—by oil gas direct as manufactured in the retorts, was about 2¼d.; but occasionally he should say it would be more like 3d. He was then engaged on some experiments in this direction; but he had not yet had time to complete them. However he could certainly support Mr. Herring's contention that the manufacture of gas from this inexpensive oil was a decidedly cheap method of enriching gas.

Mr. J. SOMERVILLE said he had been trying oil in various ways, in place of cannel, for the past twelve months or thereabouts. The best arrangement he had employed was to drive the oil into the retort with superheated steam (at about 500°) two hours after the retort had been charged. This sent the oil into the middle of the retort; and he found this was by far the best method he had tried. He had not had any experience with Mr. Herring's plan of compressing the oil; but he thought it might answer. With regard to the question of cost, he found that to raise the illuminating power of 1000 cubic feet of gas by 1 candle, it cost from 1·12d. to 1·5d.—that was, using Russian oil of ·850 specific gravity, at about 4d. per gallon delivered. At times the results obtained did not suit their gas-testing arrangements; and then they had to use a ·680 spirit, and sometimes naphtha at ·700, not in the same way, but by Clark's process. They did not use cannel at all; but they found that the Russian oil was all that was needed.

Mr. J. W. HELPS (Croydon) observed that it was only fair to an absent member to say that the arrangement which had been described by Mr. Herring had been at work at Carshalton for some few years past; the only difference being that, instead of compressing the oil in a reservoir, and then conducting it to the retort, it was taken to the retort and compressed in a sort of syringe, and forced into the retort in the form of spray. He (Mr. Helps) made some tests two or three years ago, to see what amount of enrichment was put into the gas; but he was unable to get any particulars as to the exact quantity of oil then being employed, or as to the cost of the increase in the illuminating power of the gas. The quantity of oil that was being used increased the illuminating power by 1½ candles; and this seemed to be carried a considerable distance into the town.

Mr. J. DAVIS (Gravesend) asked whether Mr. Herring had any difficulty in converting the oil into a permanent gas.

Mr. F. D. MARSHALL (Copenhagen) said that a few years ago he tried a process of enriching gas which he patented in 1876 or 1877; but in that he used superheated steam. The oil was injected into the retort; but they experienced great difficulty, as they could not get it fixed. Afterwards they passed the gas from the lower retort through the mouthpiece into another retort; and they found, by that means, they were able to fix it. The process, however, was far too expensive. It cost them 16s. per 1000 cubic feet, taking into consideration the amount of coke required for carbonizing the oil. He thought that to inject the oil into the retort was a mistake; and, in his opinion, it should be submitted to carbonization in separate apparatus. He had spoken on this subject to the Engineer of the gas-works at St. Petersburg, where, as the members knew, oil was almost a drug. Even with the low temperature there, the Engineer said he had no difficulty in fixing the gas. He told him that, in order to fix it, he carried it through a series of heated tubes; and he then injected the oil into the beginning of the condenser, and so was able to maintain a fairly high illuminating power.

The PRESIDENT said it seemed to him that this matter had been put before them in two lights. They had conflicting statements in the discussion, which must have some meaning; and he would venture to give an explanation of the cause of it. In his experience of using oil as an enricher, he had arrived at this conclusion: That before they could do anything with it, in the first place they had to convert the oil into a permanent gas; and then a suitable conveyor had to be provided. If they were manufacturers of hydrogen pure and simple, without any illuminating power whatever, and they brought it into contact with gas derived by any means from oil, they would have no difficulty in having more than a mechanical mixture. Then the gas would prove permanent and stable; but if they used oil in the way described by the author—carbonizing it in ordinary retorts, and mixing it with illuminating gas—then the difficulty they experienced was to find a proper conveyor or receptacle for those hydrocarbons which they wanted to keep with the ordinary gas. To carburet 15 or 16 candle gas was a very different thing to carburetting 13 or 14 candle gas; and before they could develop the full use of oil, he was convinced that they must make a gas of the old type—say, 14-candle gas—and then carburet it. With regard to the system described by Mr. Herring, he must join with those whose experience had been that it was not a suitable way of enriching gas. He had made some experiments with oils of various specific gravities, and used them in a retort; and he had succeeded—in fact he was determined to make its presence visible in the engine-room; but when it passed through the other apparatus, he could find no trace of it. He might also mention that he had recently proved that, if they wished to use oil of a specific gravity of ·8 or something like that, in the most satisfactory manner, the only way they could do it was by carburetting water gas. In this manner, they obtained from the oil exactly double the value that they would do when using it in an ordinary retort, and carbonizing it as they would coal.

Mr. HERRING, in reply, said, with reference to Mr. Carpenter's questions, that the oil he used had a specific gravity of ·825, and was not rectified. The illuminating power of the gas was increased 1¼ candles—from 14½ candles to 15¾. Mr. Browne stated that he did not get good results by injecting oil into his retorts, and that he injected increased quantities. That was where, in his opinion, Mr. Browne did wrong. It was necessary to use the oil in very small quantities indeed—in fact, they could not put into the retort too little at one time. Besides the oil must be compressed; otherwise it would not be broken up.

The PRESIDENT: You compress the oil before it is put into the retort, and you attach importance to that?

Mr. HERRING replied that he did. Mr. Davis had asked him whether the gas was permanent. He could only refer him to last winter, when the temperature, he thought, was equal to that of Copenhagen or St. Petersburg; and the gas then remained permanent. Facts went to show that this process effected a considerable saving, owing to the decreased quantity of cannel used, and the increased amount of coke produced. Mr. Good did not compress his oil; he simply put it into the mouthpiece of the retort where it should not go. If the retorts were single ones, the oil should be sent into the back ends; but if they were through retorts, it should fall in the centre. Then in its passage to the ascension-pipe it would become fixed, and made into a gas.

Mr. MAY asked what it cost to increase the illuminating power of the gas by 1¼ candles.

Mr. HERRING said he could hardly answer that question; but he could give the members a few interesting figures. He would take a period of four months' working in the years 1888 and 1889 when cannel was used, and the same period of 1891, when oil was employed. In 1888, it cost £136 to enrich the gas from 3337 tons of coal; in 1889, £182, with 3957 tons; and in 1891, £84, with 3954 tons. During these periods, the working conditions and the coal were practically the same; and the illuminating power was raised 1¼ candles. If they could enrich gas by any other means than cannel, the value of the coke was at once increased. In his own case, nothing but best caking coal was used; and the best coke was produced.

A vote of thanks was passed to Mr. Herring for his paper and this concluded the business before the meeting.

MANCHESTER INSTITUTION.

QUARTERLY MEETING, NOV. 28.

This Meeting was held at the Grand Hotel, Manchester—Mr. T. O. Paterson, Assoc. M. Inst. C. E., of Birkenhead (the President), in the chair.

The President opened the proceedings by giving, in the name of the Institution, a hearty welcome to Mr. W. A. Valon, the President of the Incorporated Gas Institute, who was present as a visitor.

Mr. Valon having briefly returned thanks,

The Secretary (Mr. S. S. Mellor, of Northwich) read the minutes of the previous meeting; and they were confirmed.

New Members.

Mr. J. W. Buckley, Manager of the Formby Gas-Works, was proposed for election as a member of the Institution, by Mr. E. Lord (Whitworth), seconded by Mr. J. Cockcroft (Littleborough). Mr. J. Wilkinson, of the Pudsey Gas-Works, was proposed by Mr. W. Duff (Morecambe), seconded by Mr. W. Foster (Nelson). Both gentlemen were elected.

Election of President.

The President said he had pleasure in proposing that Mr. Charles Armitage, of Lancaster, should be elected President of the Institution for the ensuing year.

Mr. W. W. Hutchinson (Barnsley) seconded the proposal; and it was carried by acclamation.

Mr. Armitage having thanked the members for the honour conferred upon him,

A discussion took place on the paper which Mr. T. Newbigging (Manchester) read at the previous meeting (*ante*, p. 247), on the subject of

Differential Rates.

Mr. Isaac Carr (Widnes) said that local authorities possessing gas-works were quite justified in charging a higher price for gas sold outside the limits of their district than they charged for that consumed within it. As the author of the paper pointed out, it had been argued that there was no real risk in owning gas-works, and that, on the ground of risk, authorities were not entitled to make any extra charge. But if this were so, there was no gainsaying the fact that there was an extra cost for distribution in distant and straggling districts. This cost was necessarily much higher in such places than in towns where the streets were all built upon. Then the cost of maintenance was also higher. At Widnes, they had an outlying village some four miles from the boundary of the town; and the expense and maintenance there was almost double that in the borough, on account of the time taken up in the transit of men and materials. A further additional cost was also incurred in index-taking and the collection of accounts. All these were good reasons why an extra charge should be made for gas supplied outside the limits of the local authority. He did not know what was the practice of gas companies; and it would be very interesting if gentlemen having charge of companies' works would tell them. Of course, with the exception of the liability of the ratepayers, gas companies were in exactly the same position as local authorities in supplying gas to distant places. Oldham was an exception to the rule, and was a place where the differential rates were not allowed. He did not know why this should be so. It appeared to him that a gas-works was like any other mercantile concern. If it was an advantage to the owners to erect the works outside the limits of their own district, they were obliged to discharge their liability for rates and so on in the district in which the works were situated; and after that liability was satisfied, he failed to see the justice of putting another tax on the undertaking by refusing to allow them to charge an extra price for gas. At Widnes, they had works outside the boundary of the local authority's district; but if the people in the out-district wanted gas at the same rate as those within the borough, he thought they would be at a loss to find any reasonable argument for the application.

Mr. C. A. Craven (Dewsbury), who was next called on by the President, said he was somewhat at a disadvantage in not having heard the paper. He might, however, say that the Corporation of Dewsbury did not charge a differential rate. About 20 per cent. of their consumption was entirely outside the borough limits; and they made no difference whatever in the price. In the adjoining borough of Batley, there was a difference of 5d. per 1000 cubic feet between the price inside and outside the town. Comparing the two practices, he preferred their own, because they hoped that at some time the out-districts would decide to become incorporated. They were a little concern at present; but when the out-districts saw that Dewsbury treated them fairly and liberally, they would eventually want to join the borough.

Mr. W. W. **Hutchinson** said he felt a little disappointed with the paper. He had hoped Mr. Newbigging would have treated of different kinds of differential rates. He should have liked to have heard that gentleman's opinion as to varying prices for gas. At Barnsley they had a sliding scale according to consumption; while a neighbouring borough had one price for all consumptions whether large or small. They might have threshed out the question which was the right course in this matter. Then he also hoped to have heard some expression of opinion with respect to a differential rate in the summer months. In order to give satisfaction to the public, they had to expend a large amount of capital on works which were very fully employed in winter, and not so much wanted in the summer. They should aim at getting such a consumption as would keep the whole plant continually at work; and he could understand that it would add to the prosperity of an undertaking to make a substantial reduction of price in the June and September quarters. In order, however that the consumers might take advantage of this without clamouring for more, they must, of course, have a calm state of things in the town; or else it would be said that gas could be produced at less cost in the winter than the summer, and so ought to be sold for less. There was also the question as to differential rates for gas used for particular purposes—such as gas-engines and cooking-stoves. A different price was charged in many towns for gas used for these purposes; and he should have liked an expression of opinion with regard to the wisdom or unwisdom of this course.

Mr. T. **Duxbury** (Darwen) said that in his case all the gas was consumed within one township; and they charged one price throughout. He happened, however, a few years ago, to be in the position of wanting to buy gas from Blackburn; and it would seem to argue against the opinion propounded by Mr. Newbigging, when he told them that (though Darwen thought it was treated rather hardly) the Blackburn Gas Committee supplied them at the same rate as they were charging their very biggest consumers—the millowners—in their own town. As to the case of Dewsbury, he expected if it became a question between Batley and Dewsbury, which could supply a certain township, the one that offered gas at the cheapest rate would get it. At Darwen they had four prices. There was first the price charged to ordinary cottage consumers. Below this was a reduction of 3d. per 1000 cubic feet to larger consumers; and an additional 2½ per cent. discount to the largest consumers—the millowners. And, besides these, they had the price of gas used for gas-engines and cooking, which was 1s. per 1000 feet less than the ordinary rate. In connection with the allowance to millowners, a rather singular claim crept in. All the millowners claimed to have the gas consumed at their residences added to that used at the mills, and to have the whole of it at 3d. per 1000 cubic feet below the ordinary price, and with the discount of 2½ per cent. Then the millowners' sons came in, and claimed to be partners, and to be put on similar terms. Next they had the shareholders in limited companies (200 or 300 in number); and they claimed the same privilege. How far the thing would have gone, he did not know; but the Gas Committee did not allow this last claim—though certainly, in a sense, they were all partners in the concern. The wisdom of their reduction to the largest consumers he very much doubted; for the capital of the concern had to be increased to supply the millowners in winter, and all this plant was idle in summer.

Mr. Newbigging suggested, before the discussion proceeded further, that they should leave the question of other differential rates on one side altogether. It would be better, he thought, to discuss his paper from the point of view which he had taken himself. There was ample scope for another paper on differential rates of another kind; and it would be far better to leave the discussion on that head until the paper was read.

The President agreed that there was certainly scope for another paper; and he suggested that perhaps Mr. Newbigging would furnish it for them.

Mr. W. A. Valon (Ramsgate), who was next called upon by the President, said he did not read the paper at the time, and had not seen it before he had had it put into his hands a moment or two ago. Therefore it would only be a very few remarks that he should pass on it; and this would be what was in his own mind, independently of any opinion he might hear afterwards, or that might be in the paper itself. He did not quite see the policy of a company or corporation charging a differential rate in the sense which Mr. Newbigging advocated—namely, to charge consumers because they lived a certain distance away a higher rate or a lower rate, as the case might be, than those who lived within the circle of their own borough. His (Mr. Valon's) reason was that the corporation or company, when they went to Parliament, asked to be allowed to supply the out-district. They obtained the permission and privilege to do it—it was a privilege—and he could not see why a consumer who lived (say) three miles from the gas-works should get gas at 3s., while another, who lived a few miles further off (beyond an imaginary line), was charged 3s. 3d. It might be that the remoter district was a populous one; and it was hard that the consumers there should be charged extra. If they extended the area of the cheaper supply to include the populous district, he imagined that the case of another district a few yards beyond that became equally hard. He considered it desirable that one uniform rate should be charged throughout a district.

Mr. W. S. Haddock (Warrington) said that, in the neighbourhood of Warrington, they had a number of small villages, and charged a differential rate of 6d. per 1000 feet per mile of main beyond the limits of the borough; and even at that price, they would prefer not to supply the out-districts with gas. In some cases they had a couple of miles of main doing nothing except carrying the gas to the outlying districts. As had been said, the cost of repairs and so on was higher than in the town, because the time occupied in going to-and-fro was longer, and there were omnibus or tram fares to pay. If a company or corporation were supplying a town, it was all very well to have one uniform price; but if the works were in a growing district, as theirs were at Warrington, it was impracticable. They did not know, when the works were laid down, which way the district would extend; and if they had not had a differential price, they must have had a fresh Act of Parliament every time they took in a new district. The differential price was an advantage to the Corporation; but not so great as appeared on the face of the figures. As the districts grew, the consumers would go in for a reduction in price; and it was quite right that they should have it, where the mains became productive.

Mr. W. R. Chester (Nottingham) remarked that if they all did as Warrington was doing, and charged a differential price of 6d. per 1000 cubic feet per mile of main, they would be able to congratulate themselves. In his own case, it would add no less than 4s. 6d. per 1000 feet to the price of the gas. They had at Nottingham no less than 24 villages, which were supplied with gas at the price charged to the largest consumers in the borough of Nottingham. That seemed now a great hardship; though there was a time when the Corporation felt it so desirable a thing to acquire the gas-works, that they consented to forego the differential charge which had previously existed, and agreed to supply the villages at the same price as the large consumers in the borough. In many respects, no doubt, these districts were supplied at greater cost than the borough could be supplied at. There was more expense in distribution, in repairs, in collecting the accounts, and so on. At the same time, they had to consider what would be the position of the gas-works in towns if these districts were cut off from them. The gas supplied to them helped to materially reduce the permanent charges; and if they were in his own case to cut off the whole of the out-town districts at one blow, they would lose something like 187 million cubic feet, or one-eighth of the total consumption. This would largely increase the fixed charges on the cost of the production of gas; and they would not be able to supply the borough at as low a price as they were now able to charge. At the same time, they ought to take a reasonable view of the matter; and if they were in a position to charge a moderate sum in excess of the price in the borough, he did not think the outside districts would raise any objection to it. It was only when corporations—which were quite as sharp as companies in looking after their own interests—added an enormous amount to the sum charged in the borough, and then took every opportunity of spending out of revenue money which should be charged to capital account, that difficulty arose with the outside consumers. They had, not far from Manchester, a borough which did this to a very large extent; and the result was that, when they came to be opposed in Parliament, they had to accept an altogether different state of things. They were forced to supply the outside districts at the same price as the inside, because they had been piling up works out of revenue. If corporations would only be reasonable, he thought there would be no difficulty in connection with the outside consumers, who would pay a small extra charge of 2d. or 3d. per 1000 feet; and this would perhaps be quite sufficient to cover the extra cost of distribution. This question of differential rates was very much wider than Mr. Newbigging's paper embraced; and it would always afford a large amount of interesting discussion. He did not think it necessary now to go into the question of different charges of this kind; though there were two sides to that question, and he should not be inclined to take up the side for a differential rate for motive power and so on.

Mr. R. Hall (Matlock Bridge) said he was Manager for a small Company which supplied gas in the district of four different local authorities. They had no differential rate—they charged all alike; and any attempt to enforce a differential rate would cause a great commotion. Small companies had always to bear in mind the necessity of continually increasing their consumption. If they could increase the consumption, they decreased the cost of manufacture; and if they could see that the revenue for laying a main was sufficient to cover the cost, it paid them to do it.

Mr. CARR rose again to say that he did not agree with the conclusion of Mr. Chester with regard to supplying outlying districts.

The PRESIDENT ruled that Mr. Carr was out of order; and then went on to say that, whatever difference of opinion might be expressed as to the subject of the paper, there was only one opinion as to the paper itself—namely, that it was a good one, and that they had learned from it something valuable, which they did not know before. He thought the question of liability should be more thought of than it had been by the speakers. The liability was certainly thrown upon the borough where a corporation owned gas-works. Whatever might come henceforth, must be borne by the ratepayers. The outlying districts had no liability whatever; and looking at it simply in that way, he thought the out-districts ought to pay something extra. At Birkenhead, they charged a round sum of 6d. per 1000 cubic feet extra to all outsiders. Their revenue for gas sold in the borough was £53,087, which was equal to £646 per mile of main; and in the out-districts they received £3874, or £250 per mile of main. Of course, size of mains and amount of capital expended had to be considered; but, on the face of it, there was nearly two-and-a-half times more revenue from the town mains than from the mains in the out-districts. In the borough they sent out 4½ million feet of gas per mile of main per annum; in the out-districts, it was only 1½ millions. They had altogether 15 per cent. of their total length of mains outside the borough, and had only 6 per cent. of their gas sold outside. The borough had considerable capital lying there; and the ratepayers' liability was covered by the extra 6d. per 1000 cubic feet, which he did not think an excessive charge at all.

Mr. NEWBIGGING, in reply, said he was very pleased with the remarks which had been made on his brief paper; and he had no doubt the discussion would be extremely useful—perhaps more so than the paper itself. Some disappointment had been expressed that he did not take up the whole subject of differential rates. The fact was the paper was written at the request of the Honorary Secretary, because some of the members who had promised papers for the previous meeting failed to keep their promises. Mr. Isaac Carr had maintained that the added cost of collection, maintenance, and so on, was a justification for a differential rate; and he (Mr. Newbigging) agreed with him. It was not just to the people in the borough, who had the responsibility of finding the capital, that they should be mulcted in a certain sum to supply outside consumers. The case of Oldham had been mentioned; and he (Mr. Newbigging) agreed with Mr. Carr that it was not fair that the differential rate should have been done away with. They must remember that Parliament was all-powerful, and might do right or wrong. It was not always a question of which was right, but of what they could obtain; and it did not follow, because Parliament said they should not have a differential rate, that it was not right to have one. Mr. Craven had stated that he did not charge a differential rate; but he explained that, by way of a bribe, he supplied the out-districts at the same price as those inside, in order to induce them to become part of the borough. This was one way of looking at it; but he did not know that Mr. Craven's constituents would exactly agree that this was the proper thing to do. Mr. Duxbury mentioned that, when he was in difficulties, he obtained a temporary supply from Blackburn; and he argued from the fact that Blackburn only charged the same price as to their own large consumers, that if they had had to supply Darwen, they would only have charged that rate. He (Mr. Newbigging) did not think this was so. [A MEMBER: Who paid for the main?] Darwen, he believed, paid for the main, and the gas was sold in bulk. It would have been a different case if the Blackburn people had laid all the mains through Darwen. Mr. Valon was labouring under the disadvantage of not having read the paper. He (Mr. Newbigging) was sorry for this, because any opinion coming from him must have great influence. Mr. Valon did not see the wisdom or the propriety of charging a differential rate to consumers because they happened to live a distance away. This was not the reason for charging such a rate. It was not because they were a distance away, but because the outside districts were usually scattered, the cost of maintenance and repairs was heavier, and they had no responsibility with regard to providing capital for the undertaking.

MR. VALON: On the other hand, they get none of the profit.

MR. NEWBIGGING said he had met this point in his paper, where he had explained that a reasonable differential rate should be charged. He did not at all agree with making an unreasonable profit, such as Mr. Chester had alluded to. Mr. Valon further said that Parliament gave power to supply a particular district. So it did; but it also allowed the differential rate.

Mr. **Valon** said this was not what he intended to convey. What he said was that a district was asked for, and was granted because it was asked for.

Mr. **Newbigging** admitted that this was so; and they asked, he said, for a differential rate, and they had it. He did not see the difference. Mr. Haddock had furnished an argument for a differential rate in saying that the cost was increased in the out-districts; but he very justly remarked that, as the districts increased in population, they would expect a reduction. So they would; and, if the corporation and their engineer were reasonable, it would be granted. Mr. Chester felt it a hardship that he could not charge a differential rate. It certainly was unfair. It was a hardship and an injustice to the consumers in the borough that they should both find capital and have to pay more for their gas in order that outside consumers should have it at a less price. He (Mr. Newbigging) was in favour of a reasonable differential rate, with a resonable profit to compensate for the risk which the ratepayers ran. They must assume that there were risks in face of the competition of electricity and oil. Mr. Chester also said that they could not charge a differential rate, because these districts might be cut off if they did. Why should they be? Salford was threatened with the loss of some of its out-districts; but this was a voluntary act on the part of Salford, and was not a course he should recommend. The proper thing was to charge a reasonable rate; and then there would be no danger of the district being cut off. He was glad to hear the experience of Mr. Hall, because it gave him the chance of explaining. In the case of a company, the whole population of a town was not liable for the capital. He was glad that the President agreed with him that a differential rate was justifiable; and he furnished an excellent argument for that opinion. The consumption per mile of main beyond the borough limits was only one-third of what it was inside; and it would be very unfair to supply those outside at the same rate as the people in the town itself. He (Mr. Newbigging) had not heard a single argument which had convinced him that a differential rate was wrong in a thickly-populated out-district.

Mr. **John West** (Manchester) then read a paper

ON STOKING MACHINERY, ETC.

The author commenced by stating that, on being asked by the President to read a paper giving the members some information specially bearing upon his manual-power machinery for drawing and charging retorts for small and moderate sized works, he at first asked to be excused; but eventually consented, on the understanding that he should be allowed to introduce other matters connected with the subject which might present themselves to his mind. He then proceeded as follows:

No doubt most of you will have seen a paper I read before the North British Association a short time ago [*ante*, p. 154], when I went fully into the question of machinery, and laid a number of important statistics before the Association; and only a few days ago another paper was read before the Southern District Association by Mr. J. Tysoe, of the South Metropolitan Gas-Works, East Greenwich, which dealt almost solely with the power machinery [*ante*, p. 322]. I do not, therefore, think that it will be necessary for me to go over the whole of the ground again. The title of my paper would have been better expressed had it read: "A Paper on some of the Means employed for Reducing the Cost of the Manufacture and Distribution of Gas, and on Popularizing its Use;" and I think I shall be able to show that these subjects are very intimately connected with stoking and other machinery.

I believe you will all agree with me that this is a progressive age, and that it will not answer—especially in the profession or business in which we are all engaged—to rest on our oars; and although I am well aware that much has already been done to increase and popularize the use of gas in various quarters, by holding exhibitions of gas appliances, by letting out fittings on hire, and by introducing prepayment meters, with most excellent results, yet I know that there is a very considerable amount of fallow land in various districts, requiring cultivation and looking after to make it productive. I am one of those who have always believed that gas companies and corporations should both make the articles they supply, and guide, assist, or instruct their customers in the proper and economical use of them; and the longer I live, and the more I observe both sides of the question, the more firmly am I impressed with the wisdom of that belief.

For more than 25 years I was intimately connected with companies who, from the first, not only made gas, but also all the appliances required for lighting, cooking, and heating with it, and kept a staff of specially-trained fitters. Where this system has been carried out, the customers get their work done better and cheaper, and are instructed in the use of all the most modern appliances; consequently, the consumption is increased, and the mains are more fully utilized on account of the greater day consumption. I could give you many excellent examples in proof of this assertion; but I will only refer you to one I heard spoken of about six years ago, by Mr. Newbigging, in his presidential address, after he had collected information from various towns as to the quantity of gas that was being consumed during the night and day. He told us that at Northampton the annual consumption of gas was 215 million cubic feet, and 90 million cubic feet of this (or more than two-fifths of the whole) were used for purposes other than lighting. There were in use in the town of Northampton 250 gas-fires, 2700 cooking and boiling apparatus, 400 small stoves used by shoemakers for heating their finishing-irons, and 40 gas-engines. I at once saw the reason of this. This is the town where, in my younger days (35 years ago), I saw cooking apparatus being manufactured and sold at a very low figure.

Some of you have held gas exhibitions for the introduction of cooking, heating, and motive power; and, so far, you have done well. But I advise you not to stop there, nor rest content until you can properly get at and advise the consumers as to the most suitable and economical burners for their special requirements. I know that some of you have your hands somewhat tied in this matter, on account of what is called the trading or gas-fitting element; but why corporations or gas companies should neglect their duty towards their many thousands of customers in deference to a few of these gentlemen, I am at a loss to understand. I look upon them as very useful adjuncts indeed, when properly trained; and I know many who do their work well. But there are others who require a little teaching; and it would be an advantage to both the buyer and seller of gas if each of you had a few qualified men about you, to set a good example of work in your various towns. If you had a tolerably free hand in propagating the use of gas, I have no hesitation in saying that you would be the best possible friends to the gas-fitters in your district.

I am aware that there are gas managers who have really no opportunity of communication between the gas-works and the consumer, except when an inspector or collector calls periodically for the account; and there is no doubt that in such cases both the maker and user of gas suffer from the want of such communication. I think the time has now arrived when all companies and corporations should treat the important and valuable concern handed down to them on truly commercial lines, and on a par with other large business establishments. It is certainly their duty to protect and hand down unimpaired, and, if possible to improve the position of the undertakings of which the directors, aldermen, and committees are the responsible trustees. It is now accepted that there are competitors in the field; and I think it is nothing but fair to all parties that the gas interest should be placed on the same commercial basis as its competitors, and that those who have the responsibility, management, and charge of gas-works, should have a freer hand than they have had in advocating the many and various advantages obtained by the proper use of gas for lighting, cooking, heating, and other purposes.

As one of the most recent examples of what can be done in this respect, I desire to refer you to a report in the *Journal of Gas Lighting* for Oct. 20 last (p. 719), from Mr. F. D. Marshall, the Chief Engineer of the Danish Gas Company, to the Directors of that Company; and also to the leading article on the subject. Here we find a Gas Company, chiefly composed of Englishmen, which has ten works in various parts of Denmark and Germany, and which has increased its consumption of gas by "leaps and bounds"—the extra consumption this year over last being for lighting gas, 6 per cent.; for cooking gas, 63 per cent.; and for motive power gas, 15·5 per cent. Taking a comparison of the consumption in 1881 and 1891, the ratios of increase are as follows: Lighting gas, 105 per cent.; cooking gas, 218 per cent.; motive power gas, 540 per cent.

I was certainly struck with some of these figures; and when Mr. Marshall was in England recently, I had the opportunity of spending some time with him. I then particularly inquired of him the means employed in bringing about these extraordinary results; and I think it will not be out of place if I endeavour to give you his explanation.

In the first place, I understand that he has a very intelligent and progressive Board in London, who give him almost *carte blanche* to introduce gas lighting and heating in the various towns in which he has control of the gas-works. For this purpose, the most modern burners and best appliances, for both heating and lighting purposes, are obtained. They have various show-rooms where these goods are displayed; and lectures on burners and cookery, and other matters, are frequently brought prominently before the public. Another very important feature comes into the calculation. I believe all the Managers in the various towns are interested in furthering the supply of gas. I cannot tell you how this is worked out, but there is a kind of bonus system in operation; and this plan is found to work most successfully for all parties concerned, as the Managers are engaged and paid by results to look after both the works and the public, and to increase the consumption as much as possible. I have no doubt they work very cheerfully, seeing that they have a direct interest in the prosperity of the undertaking. In some towns, Mr. Marshall pointed out that there were whole streets where they had persuaded the users of some of the best oil and petroleum lamps to give them up, and adopt regenerative gas-lamps, which they could either buy or hire. One thing I arrived at was that there was a unanimity of feeling permeating the Directors, Engineers, and Managers, which no doubt tended largely to the great success achieved.

All this sort of thing requires perseverance, tact, and skill to bring about; but surely you must all admit that the great advantages derived are worth the trouble incurred. The towns referred to in Denmark are not very large; but there are a number of towns of similar size in England where I believe even better results might be obtained if the same policy was carried out. As to cities and large towns, several show-rooms, thoroughly equipped with all appliances for lighting, cooking, heating, and motive power, should be provided in various districts, with suitable persons to give lectures, and explain their advantages, so that the public may be thoroughly educated in the many benefits which might be derived from the use of gas.

Some of you hold the position of being connected with corporations which supply, or think of supplying, both gas and electricity. On this question I expressed my views to another Engineering Association in this building at the beginning of the year; and I feel that I cannot do better than give them to you in the same words—

> Those of us who are citizens, gas consumers, and ratepayers, are very much interested in the progress of our gas undertaking, and should urge the Council to make any electric installation totally distinct from the Gas Department, or from any other department of the Corporation, so that the ratepayers, and all others interested, may see the exact amount of profit and loss, just as they can now do by inspection of the accounts of the Gas Department. I think I shall be able to show that various interests are involved in this subject. At the present time the Gas Department is deriving profits from the consumers of gas, who, of course, are now paying their fair proportion towards the public lighting and rates of the city. The profit made by the Gas Department is passed on to the funds of the city, and the rates are consequently lower than would be the case if no profit were made. If, therefore, the electric light supersedes gas in a certain area, the profits now derived from that area may be sacrificed; and unless those using the electric light pay such a price as will secure the same profit to the electric light department as that previously received by the Gas Department, the

difference will indirectly come from the gas consumers or some other source. If, however, the same profits are derived from the users of electricity, it becomes immaterial to the Corporation which illuminant they supply to the public; but if this is not carried out, I fear that the consumers of gas, who already pay a proportion of the rates of the non-consumers, will also have the additional burden imposed upon them of paying a portion of the electric light users' rates as well. The Council have, very recently, relieved the Gas Department of the burden of the public lighting of the city, by reverting to the old plan of direct taxation; so that the non-consumers and electric light users will very properly be called upon to pay their fair share of the lighting rate in the future.

I must again take the opportunity of impressing upon the gas consumers the desirability of economically improving their present antiquated system of gas lighting, by adopting the modern regenerative or other burners, whereby they can ventilate their rooms, and get an equivalent light at from 2½ to 3½ times less cost (after allowing a very large margin for defective burners) than the Corporation would be able to supply the electric light for from a large central station, as the following calculations will show:—

Incandescent Lamp.

A 16-candle power lamp lasts 1000 hours, and absorbs 60 units of electricity, which, at 8d. per unit, cost 40s.

Ordinary Gas-Burner with Manchester Gas.

16-candle power is equivalent to 4 cubic feet of gas per hour, or 4000 cubic feet in 1000 hours, the cost of which, at 2s. 6d. per 1000 cubic feet, is 10s.

In the above calculation, I have assumed that the Corporation charge the Board of Trade limit of 8d. per unit for the electric light; and even at that figure I have grave doubts if they would be able, after paying working expenses, repairs and maintenance, and providing for a sinking fund, to hand over any profit to the Council, as is at present done by the Gas Department.

My view of the matter is that, if anyone is desirous of indulging in the somewhat fashionable and expensive electric light, by all means let him do so; but I desire not to be asked to pay any part of his bill for him. If the electric light stands on its own bottom in Manchester and other places, it will not make much headway against good and cheap gas properly consumed.

I think you will admit that, if the means suggested are employed, there would be a very considerable increase in the consumption of gas for various purposes. This would bring a larger daily consumption, and also a better utilization of your mains, which in some cases are practically dormant for many hours during the day, and your leakage would thereby be reduced. You would soon require more plant on the works to meet your increased demand, especially stoking machinery, the advantage of which cannot be too highly appreciated by both the maker and the user of gas, as it tends to cheapen the cost of production.

Like every other improvement, machinery for drawing and charging retorts was looked upon for some time as an innovation; but I am glad to say that it is now being used by those who formerly did not think that it was possible for it to supersede hand labour. It is, however, now an established fact that for years past, where it has been in full operation, the work has been done much cheaper, and the results far exceed those upon the old system of working; and I believe that it is now almost universally accepted that machinery will be generally adopted in future.

As you are aware, we make two kinds of machines to meet the requirements of large, medium, and small works. Those worked by power, with ropes, or compressed air, can be profitably applied in large towns where the machinery can be well occupied; but, inasmuch as your President desired that I should say more about the manual machine for medium and small-sized works, I will only give you a few illustrations of the saving in labour that can be effected by the power machinery. [The author then quoted the figures given in his paper read before the North British Association of Gas Managers in July last (see *ante*, p. 165), showing the relative difference in cost between hand labour and power machinery, as exemplified at the Whitwood Chemical Works, the South Metropolitan Gas-Works, and the Aberdeen Corporation Gas-Works.]

The manual machines were the first I introduced; and I will give you a very brief description of the apparatus as it exists at the present time. I found that, in order to make the machinery work successfully, it was necessary to have the coal of uniform size, and conveyed from the stores into the charging-scoop at a minimum cost. To accomplish this, I designed a coal-breaker, elevator, and conveyors to carry the broken coal into the retort-house. Fixed store hoppers were provided in such a position that the machines travelled under them; and by having in the charging-machine an adjustable hopper capable of carrying sufficient coal for a dozen or more charges, with a frame attached for carrying the charger, the item for coal trimming and wheeling was reduced to an exceedingly low figure. It is an advantage, in designing new retort-houses, to erect coal-stores on either side of the house; and, if possible, provision should be made for an overhead railway running through them, so that the coal can be tipped direct from the truck into the coal-breaker by opening the doors at the sides or bottom, or by lifting the waggon by the buffers at one end, and letting the coal run out at the other, as in the case of the arrangement now at the Oldham Gas-Works.

Mr. Baker, of Reading, designed a somewhat similar arrangement for his retort-house in connection with my machinery.

The position of the coal-stores in relation to the retort-house in works already erected is no bar whatever to the application of machinery, for the comparative saving in labour is greater in those works where the stores are separated and at a distance from the retort-house, by using a system of conveyors, as illustrated in the case of Folkestone, Belfast, Cheltenham, Sheffield, Birmingham, &c.; thus dispensing altogether with the serious item of coal wheeling. Indeed, it is in this direction that a great portion of the saving is effected—a fact which I recognized when first attempting to deal with the question of labour-saving appliances in the retort-house.

These machines have, I believe, been brought to a state as near perfection as they can be, if we may judge from the fact that they have undergone very little alteration during the past few years, and have given universal satisfaction wherever they have been installed. As is well known, they depend more upon the strength of the stoker than do the other classes of machinery; but the skill required to work them is even less than with the power machines, as there are only a few simple movements to be made, and less mechanism to look after. The charger I use with these machines deposits the most perfect layer of coals in the retort that it is possible to imagine, and renders bad charging by unskilled men quite out of the range of possibility. Indeed, an expert man is far more likely to charge badly than a novice, because he learns tricks to save time by not letting the charger run its full course, or by turning the scoops before the proper time. The saving in cost of labour by these manual machines is such as to justify me in urging their universal adoption in all gas-works where there are not sufficient retorts to employ economically the more costly power machines.

There are one or two points of vital importance in the designing of retort-houses for machinery. In the first place, let me impress upon you the necessity for having mouthpieces of the same section throughout as your retort; in fact, an increase of the section all round by ⅛-inch would be a great advantage, for, if the mouthpieces are at all contracted, the coke very often jams hard in them, and throws a great strain upon the men and mouthpieces. Again, the varieties in the section of the retorts at different works, and very often at the same works and in the same house, are a great drawback to working machines economically. All the retorts in a house should be of like section; and every retort in a tier should be at exactly the same height from the floor. When these details are carried out, the best results are obtained; and by adopting, when making renewals, a section of retort to which either manual or power machinery could be equally well applied, the introduction of machinery in the future would not be accompanied by any additional expense beyond that incurred in the purchase of it.

From large experience in the working of all kinds of settings, I am fully convinced that the best sizes of retorts for small and medium-sized works are those recommended by me when my manual machines were first introduced—viz., 21 in. by 15 in., 21 in. by 15½ in., 22 in. by 15 in., and 22 in. by 16 in. ⌓ shape. These sizes will be equally suitable for working either with or without machinery. In larger works, where power machines can be economically employed, a somewhat larger variation can be allowed for. Any section of retort can be charged by the power machines, but the sizes most suitable are: 21 in. by 15 in. oval; and 20 in. by 15 in., 21 in. by 15 in., 22 in. by 15 in., and 22 in. by 16 in. ⌓ shape.

The retort mouthpiece lids require special attention, as they must be arranged to close back to allow the machines to pass. The distance from the face of the retort-stack to the machines is 2 ft. 6 in.; and the lids and fittings will be required to fully clear this, both when they are open and when closed. Again, the hinges should be made so that the lids are closed in the same direction as the travel of the machines when at work.

Some of the difficulties we have to contend with are the unsuitability of certain of the old-fashioned retort-houses, for want of space between the retorts and the wall or columns for supporting the roof; but most modern retort-houses have, for some time past, been arranged with the ultimate idea of adopting machinery. I regret, however, to say that, in the case of two recent examples of new houses, we had to report that machinery could not be applied, on account of the exceptionally narrow space between the retort-stack and the columns. I need hardly remark that these structures were not designed by intelligent and practical gas engineers. I recently obtained working results, giving the cost of labour and wear and tear, from a number of engineers at works where my manual power machinery has been in operation for some years; and I have just received a report of the cost of working from Mr. S. Glover, Engineer and Manager of the St. Helens Gas-Works, Lancashire. [The report alluded to showed that the annual make of gas at St. Helens is 200 million cubic feet. Manual machinery was erected there in the year 1887, with the result that the wages for stoking, &c., were brought down from 2s. 8d. to 1s. 8·89d. per ton of coal carbonized. The author also reproduced the returns from Maidstone, Tunbridge Wells, Ramsgate, Westgate, and Folkestone, included in his paper read before the North British Association, previously referred to, as well as the table furnishing particulars in regard to the working of manual machinery at Portsea, Cheltenham, Richmond, and Reading, contained in his paper read before The Gas Institute at Ryde last year, and given in the Institute's Transactions for 1890, p. 64.]

In some cases where the hand and machine systems are in joint operation, I cannot get complete returns, because of the difficulty of separating the gas produced under the two systems, and the trouble of keeping separate records of weights of coal. But in these cases they inform me that they will be pleased to speak most highly of the machinery, and will be glad to give any information in their power. I think, however, that the many facts laid before you from a large number of engineers, with whom most of you are personally acquainted, testifying to the excellent results obtained by the adoption of the system, prove conclusively that the time has arrived when, if you wish to be in the first rank of progress, it will be necessary for you to adopt these labour-saving appliances. In making a comparison, I have always endeavoured to include the various items of cost, from the taking of the coal from the stores to the tipping and quenching of the coke in the yard; and if the number of retorts in any house, the number of men employed, and the rate of wages are given, we can generally estimate very nearly what it will cost by machinery, and show the saving that would be gained by its adoption in any district throughout the United Kingdom. Time will not permit of my saying more, or I could point out many examples where the application of coal breaking, elevating, and conveying machinery can be utilized in gas-works, with very considerable advantage and saving.

I have no intention of entering upon a lengthy newspaper controversy, and am therefore reluctant to set right a few misconceptions which appeared in an article in the *Journal of Gas Lighting* for Nov. 17 (p. 888); but as the contents of the newspapers are frequently the unspoken thoughts of many minds, I venture, at the risk of calling down upon my head the censure of the leader writer, to show how far he is from duly appreciating all the established facts of engineering science. The remark to which I would call attention is the one where it is maintained that, "weight for weight, the human worker is a far more efficient agent for performing the operation of coal carbonization than the machine which is offered in his stead." Of course, this is a fact; and the statement might be extended to many other industries and with other animals as well as the human one. But, for all that, the machine makes up for its want of weight-efficiency by its possession of a constitution which can bear almost any amount of labour without fatigue; and it is consequently a much cheaper thing, as a tool, than any animal. It is well known that two horses, weighing about a ton, will draw a tramcar as well as an engine weighing 8 tons; but the horses can only work 4 hours out of a day, as against the 15 or even 24 hours of the engine. Take the case of the locomotive as another instance. Who would propose to use horses to take trains from Manchester to London because, "weight for weight," the horse is a more efficient agent than the locomotive? Could any number of horses take an ordinary express from Manchester to London in 4½ hours? The human stoker fails to equal the machine just at the same point where the horse fails against the locomotive. Neither can we do the same amount of work in the same time, nor so much of it.

It seems also that the *Journal of Gas Lighting* has yet to learn where any gas-works exist which depend wholly upon machinery. The Rochdale Road works in this city, where they make about 8 million cubic feet of gas per day, are an example, as are also Ramsgate, Folkestone, Tunbridge Wells, and many other towns; and it is a fact that better results are shown in many of these places than are ever produced by hand work continuously. As regards the remark that it is greatly to be wished that this subject could be "treated from time to time with a little more freshness," I can only say again that this was my idea when your President asked me to write this paper, as I was aware that even the language of universal approval which stoking machinery gets on all sides, might grow stale after frequent repetition.

Discussion.

The PRESIDENT having invited Mr. W. A. Valon to open the discussion on the paper,

Mr. VALON said he accepted the President's invitation with more pleasure because he thought the members of the Institution knew his opinion with regard to the latter part, if not the former part, of the paper. The first portion treated of the extension of the consumption of gas by companies judiciously encouraging it in their districts. Well, he was able to say a little on this subject from the fact that at Ramsgate they had, during the last two years, done more in this direction than before. They commenced by putting pipes in small houses—those with a rateable value below £30. They did this because they found that gas was not being burnt in houses where it ought to be used, as the occupiers could not afford to put in the pipes. He made inquiries, both personally and through the meter inspectors; and as the result, he recommended the Corporation of Ramsgate to undertake to fit up houses of a rental of from £10 to £30 per annum. This was done—a prepayment meter being used; and they charged for the gas consumed at the rate of 4½d. per 100 cubic feet, or 7d. per 1000 cubic feet, more than to ordinary consumers. A considerable number of houses were fitted up. The inspectors found that some people burnt more than double the quantity of gas paid for in advance; and the outcome of this was the adoption of a stop-index. This was turned forward to stop at any quantity the consumer pleased; and the money was paid in advance for this quantity—the difference being adjusted when the inspector next called, and the index reset. Of course, these meters were used for the smaller rather than the larger houses. Their next step was to lend consumers small boiling-stoves free of cost; and in some cases this had led to the purchase of larger cooking-stoves. The result was that they had 538 small consumers on this system in less than two years. The average cost of fitting up the houses was a little more than £3. This was not a serious matter; for if they fitted a thousand houses it only cost £3000. The wear and tear was very little. They used fast brackets, and did not go in for elaborate chandeliers, or anything of that kind. Mr. West had referred to the difficulty of getting the control of the fittings into the hands of corporations and companies, and to the conflict into which they got with the fitters. This difficulty they overcame at Ramsgate by an arrangement that any fitters who would undertake, at scheduled prices, to fit up these houses should be allowed to do so; the work being given out fairly amongst the whole number, on the condition that they should do their work under the inspector, and to his satisfaction. They also said to the gas-fitters: "If you bring anyone who requires his house fitted up on this system, the work will be yours, as a matter of course." The consequence was the fitters were satisfied, and so were the Corporation. All he need add, with reference to the other subject mentioned in the paper, was that the manual stoking-machines they had in use at Ramsgate had given entire satisfaction. The wear and tear was exceedingly light. The advantages of machinery were set forth fairly and truthfully in the paper; and he, as an Engineer, rejoiced to find that it was pushing its way into gas-works. So long as men were willing and their labour was cheap, they had been content to take things as they were. But circumstances had changed; and he thought they might now adopt machinery, and at the same time retain the good-will of the men. His testimony was that, taking it all round, there was no machinery—and this applied especially to the manual machinery—on which he should place so much reliance as on that of Mr. West.

Mr. W. R. CHESTER (Nottingham) said that the subject of the paper was one in which they were all more or less interested; indeed, they ought to be more so than they were. The title might perhaps have been altered to "On Things in General," for Mr. West had something to say on the subject of electric lighting, manual and power stoking-machines, distribution, and the general management of gas-works—on all of which questions he was able to express a very reliable opinion. As to machinery, very few people would now deny that a large saving could be effected by its use. Of course, power machines were best, provided the works were large enough to justify the expenditure of the capital necessary to provide them. Where the works were not sufficiently extensive to utilize power machines to advantage, hand machines could be worked at a saving of 1s. per ton of coal carbonized; while if power machines could be introduced, there was a further saving of something like 30 per cent. In Manchester they had both. They were working first with considerable economy with the hand machines; but when the power machines were put in, the cost of stoking was reduced something like 30 per cent. He understood from Mr. West that this result had not only been confirmed, but had been improved upon in some places. A reduction of 1s. per ton on the total quantity of coal carbonized was such a considerable sum, that everybody should feel compelled to effect it if possible. At Nottingham most of the retort-houses were so constructed that machinery could not be used in them; and they had to continue on the old lines. As to the electric light, he did not agree with Mr. West that the owners of gas-works should not undertake its supply. The time had now come when both large and small towns would demand that the new light should be introduced; and the cost would not stand in the way of people who desired to have it on their premises. In certain directions, it undoubtedly possessed advantages over gas; and if it was to be employed, who could supply it better or more reasonably than the manufacturers of gas? If there were two lighting bodies in a town, they would get into competition; and although the consumers would ultimately reap the benefit, the town at large would be subjected to great disadvantage. He held with what was being done by many corporations throughout the country who had placed the power to supply the electric light in the hands of the gas committee, so that, if any profits were to be derived from it, they could be set off against any possible loss of revenue from the sale of gas.

Mr. J. CHADWICK (Oldham) said he did not understand Mr. West's remarks about electric lighting as Mr. Chester did. What he understood Mr. West to say was that, in the event of a corporation undertaking to supply the electric light, it should be kept as a distinct account, just as the accounts of water-works were now kept separate from those of gas-works in a combined undertaking. In this, he agreed with Mr. West. If corporations were to undertake to supply the electric light—and he was far from saying they should not do so—the accounts ought to be kept quite distinct from all others. There were several reasons why corporations might desire to supply the light, in the event of its being required in a district. One was that they might keep in their own hands the control of the roads and streets, which was a very important matter to local authorities. Referring to the question of machinery, there were many reasons why gas managers had felt compelled to adopt labour-saving appliances; and in every case he believed their use had been beneficial. The coal haulage machinery which they laid down had, no doubt, proved a very great saving and convenience to the Oldham Corporation Gas Committee. It was about twelve months since they erected the first part of the apparatus; and since then it had been working continuously, and they had had no trouble with it. It had done its work well, and had never gone on strike. They had two machines erected, each capable of doing all their work, or even more; and they were in this position—that, if one was temporarily stopped, they could turn to the other. One of the machines was now regularly dealing with between 200 and 300 tons of coal per day; and it had dealt with 30,000 or 40,000 tons, and had never cost a penny for repairs. It might be thought that belts working among so much coal-dust would become affected. They had not found this to be the case, though, of course, they took a great deal of trouble to avoid it, by seeing that the belts were kept clean and well oiled. They accomplished work at present with three men only which used to take twenty. The machinery was giving every satisfaction; and it would not be the last labour-saving appliance they would adopt. He had an idea that haulage machinery might be employed for coke as well as coal; and he hoped before long to be able to use stoking machinery also.

Mr. H. SIMMONDS (Colne) said that for several years he had experience of stoking machinery at Cheltenham. There they had a retort-house with twelve beds, 96 retorts on one side, and a make of 1¼ million cubic feet; and double machinery was laid down. The chief point, in his experience, was that machinery could be adopted in smaller works with equal success. At Colne, they had a make of about half a million cubic feet of gas per day; and there they had a single retort-house with only one set of machinery. This had been running for about two months; and he had obtained a few figures as to the result. The house was not quite finished. It was designed for twelve beds of eight retorts; and they were now working eight beds. They carbonized 250 tons of coal per week; and they had nine stokers at 32s. a week, two firemen looking after the regenerator furnaces, two engine men at 28s. a week, and two coke men,—the total cost being 1s. 9⅝d. per ton. If they had been working by hand, they would have required fifteen stokers, two firemen, four coke men, and two coke wheelers; and the average then would have been 2s. 8d. per ton. So that he was saving nearly 1s. per ton; and besides this the stokers did the work much quicker, and increased results were accordingly obtained from the coal. This went into the retort in a body, and before it had time to start carbonizing, the lid was on; whereas under the old system it was carbonizing as it was thrown in by shovelfuls.

The PRESIDENT, in closing the discussion, remarked that the members were indebted to Mr. West for a very practical and useful paper. No man had had more experience in the retort-house than Mr. West, who had given much study to the question of reducing to a minimum the labour in that part of the works. He was, they had heard, working as low as 1s. 4d. per ton. He (the President) only wished he could get down to this figure; it would pay for a good many machines. He was very glad to hear that Mr. Valon was making such good progress in popularizing the use of gas. The facts he had brought before the meeting were very encouraging. At Birkenhead, they had a large number of houses in which oil was burned; and so far they had not succeeded in getting at them. A few years ago he tried to do something of the kind; but it was crushed out by the Town Council, because of the small local interests which it was thought it might injure. He did not think his plan would have been any disadvantage to these people. If it had been, they were very few; and the majority ought to rule. The discussion on the subject of public bodies and the adoption of the electric light would, he supposed, always go on. His idea was that it was the proper course for corporations to obtain the necessary powers for supplying the light, and either carry them out themselves, or delegate them to a company. They must look upon the electric light as a competitor; but, if they took it up in a fair spirit, they had nothing to fear. It was a very long way behind in the matter of cost; but there were some people in all towns who would have it, no matter what the expense might be.

Mr. West, in reply, said the example of Mr. Valon in extending the use of gas might be followed by others. By employing a prepayment meter, he was paid by the small consumers before the gas was delivered; and he further popularized the use of gas by lending stoves free of cost. This was his (Mr. West's) idea exactly; for he believed that, if the claims of gas were put forward on businesslike lines, the result would be found to be satisfactory. Mr. Valon had also solved the problem of satisfying the gas-fitter. Mr. Valon's use of machinery was coincident with his attempt to popularize gas; and the result was that he had had to order more machinery. Perhaps no one had had greater experience of stoking machinery in Manchester than Mr. Chester; and he had correctly told the meeting the advantage of power over hand machinery. He had, however, misunderstood his (Mr. West's) reference to the electric light. He had no objection whatever to corporations taking up the light; but, if they did so, they should supply it on commercial lines. They should allow all people to have it who wished, and let them pay for it. If it displaced gas, it would not then matter, because they would be getting the same profit out of electricity. At the same time, if they took a leaf out of Mr. Chester's book, and fitted up public buildings, as he had done at Nottingham, with regenerative lamps, and paid attention to ventilation, the electricians would have very little show. He (Mr. West) was glad that Mr. Chadwick was present, and that they had heard his statement about the electric light. Mr. Simmonds had told them of his experience at Cheltenham, and also at Colne, where, with very small works, he had, by using machinery, reduced the cost from 2s. 9d. to 1s. 9d. per ton of coal carbonized. Mr. West went on to refer to a picture in that day's *Graphic*, representing a retort-house where machinery was in use. He stated that it was a most incorrect illustration, for it represented stokers as half naked—a state of things which did not prevail in any works where machinery was employed.

VOTE OF THANKS.

Mr. **CHESTER** moved a hearty vote of thanks to Mr. West for his paper.

Mr. T. **DUXBURY** (Darwen) seconded the motion; remarking that the information the members had obtained would be of great use to them. He added that there was no stoking machinery at the Darwen works; but the time was not, he thought, far distant when there would be.

The resolution was carried, and the formal proceedings then ended.

The members subsequently took tea together.

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Thorman, J.	West Ham.
Tysoe, J.	East Greenwich.
Valon, W. A.	Ramsgate.
Wadeson, J.	Windsor.
Watson, J. C.	Lower Sydenham.
Webb, T.	Egham.
West, J.	Manchester.
White, T. W. R.	Sherborne.
Wilson, G.	Lewes.
Wilton, J.	Silvertown.
Winter, A. F.	Sevenoaks.
Wood, W.	Walton-on-Thames.
Woodall, C.	Palace Chambers, Westminster.
Woodward, W.	Bromley.

SOUTH-WEST OF ENGLAND DISTRICT
ASSOCIATION OF GAS MANAGERS.

President.

S. W. DURKIN, Southampton.
(PRESIDENT for 1892: D. Irving, Bristol.)

Vice-President.

E. C. RILEY, Swindon.

Honorary Secretary and Treasurer.

N. H. HUMPHRYS, Salisbury.

Committee.

J. H. SILCOX, Pembroke Dock.
W. DAVIS, Poole.
S. BARK, Godalming.

NEW MEMBERS OF COMMITTEE FOR 1891-92.

J. NICHOLLS, Crewkerne.
W. PARLBY, Hereford.
F. OSMOND, Dorchester.

Auditor.

W. HIGGS, Basingstoke.

Members.

Ashton, R.	Barnstaple.
Bark, S.	Godalming.
Bennett, W. C.	Tiverton.
Bennett, C. V.	Wells.
Beynon, R.	Torquay.
Brace, W.	Monmouth.
Brinkworth, W. H.	Chippenham.
Budd, W.	Melksham.
Copp, W. L.	Watchet.
Cornish, J. H.	Bridgwater.
Daniel, A. V.	Portishead.
Davis, W.	Poole.

Dexter, F. G.	Winchester.
Durkin, F.	Southampton.
Durkin, S. W.	Southampton.
Ely, J.	Abingdon.
Farrand, F. F.	Ryde, Isle of Wight.
Faulkner, J.	G. W. Ry., Swindon.
Faulkner, W.	Romsey.
Garnett, G.	Ryde, Isle of Wight.
Giles, T.	Bridport.
Gough, J. G.	Calne.
Gravett, H.	Bradford-on-Avon.
Gray, J. H.	Weston-super-Mare.
Griffin, J.	Fareham.
Hardick, T.	Salisbury.
Harris, F.	Barry.
Higgs, W.	Basingstoke.
Hopper, J. H.	Glastonbury.
Howell, E.	Yeovil.
Humphrys, N. H.	Salisbury.
Ineson, J. S.	Ventnor, I. of W.
Irving, D.	Bristol.
James, J. D.	Exmouth.
Jervis, J. J.	New Swindon.
Kilminster, W. E.	Truro.
Livesey, D. T.	Aldershot.
Lloyd, E. J.	Guildford.
Lowe, J.	Weymouth.
Lowe, W.	Weymouth.
Lyon, J. H.	Cosham.
Newman, J.	Sandown, I. of W.
Nicholls, J.	Crewkerne.
Osmond, F.	Dorchester.
Padfield, W. A.	Exeter.
Parlby, W.	Hereford.
Phelps, Joseph	Marlborough.
Reed, J.	Newport, I. of W.
Riley, E. C.	G. W. Ry., Swindon.
Robb, J.	Cinderford.
Sainsbury, H.	Trowbridge.
Sapey, E. D.	Horsham.
Shepherd, H. C.	Old Swindon.
Silcox, J. H.	Pembroke Dock.
Stagg, W.	Bristol.
Stallard, G.	Havant.
Stone, T.	Weymouth.
Tall, J.	Dartmouth.
Taylor, F. C.	Shanklin.
Temblett, S.	Andover.
Thomas, A.	West Cowes.
Thomas, J.	Bodmin.
Thomas, P.	Wellington.
Tinney, W. U.	Winchester.
Townsend, H.	Plymouth.
Turner, F.	Chard.

Vince, F.	Trowbridge.
Vincent, H. F.	Frome.
Vinson, W. E.	Gloucester.
Walker, G.	Wantage.
Walker, W. A.	Worthing.
White, T. W. R.	Sherborne.
Willey, H. F.	Exeter.